ISBN: 978-81-909047-9-7, p-ISSN:2249-2569, e-ISSN:2320-2955

"THE EXALTED"
DIGITAL EDITION

INTERNATIONAL RESEARCH JOURNAL OF HUMANITIES, ENGINEERING & PHARMACEUTICAL SCIENCES

(An International Registered Research Journal)

www.ijheps.org

2.889
IMPACT FACTOR

सर्वे भवन्तुः सुखिनः

"THINK BEYOND TO CREATE MIRACLES"

Promoted By: Association for Innovation, INDIA
(Under the Society Registration Act, 1860, a govt. registered organization with registration no. 2241)

"THE EXALTED EDITION"

IJHEPS/JANUARY 2015

TABLE OF CONTENT

ARTICLE	TITLE/AUTHOR
1	HUBBUS OF RESEARCH TERMINOLOGIES: LET CAT OUT OF BAG
2	ANALYSIS OF CONVENTIONAL TRANSMISSION LOSS AND DEPTH DEPENDENCE IN CONTEXT OF UNDERWATER ACOUSTIC COMMUNICATION
3	GETTING STARTED IN DOCTORAL RESEARCH: A PRIMER
4	ANALYSIS OF INDIVIDUAL AND BACTRIAL CONSORTIUM OF BROTH CULTURE OF PSEUDOMONAS AERUGINOSA, SERRATIA MARSCECENS AND BACILLUS SUBTILIS TO OILS AND HYDROCARBONS
5	CROP CONCENTRATION AND THEIR CHANGES IN DROUGHT- PRONE AREAS IN JALGAON DISTRICT, MAHARASHTRA, USING GEOGRAPHIC INFORMATION SYSTEM
6	STUDY OF STRESS AT WORK PLACE AMONG MANAGEMENT FACULTY
7	WATER: A MILLION DOLLAR CRISIS OF 21ST CENTUARY IN INDIA
8	THE EFFECT OF COUNTERFORCE EXERCISES ON LEF AND BACK STRENGHT OF MIDDLE DISTANCE RUNNERS
9	MISHING'S APONG-AN INTAGIBLE CULTURE HERITAGE OF ASSAM
10	UNIT DOSAGES FORM TABLET-AN OVERVIEW

ARTICLE 1

HUBBUBS OF RESEARCH TERMINOLOGIES: LET CAT OUT OF BAG

Anchal Garg[1], Madhurima[2*], Madhulika[1], Saru Dhir[2]
[1.2]Assistant Professor, [1]Department of Computer Science & Engineering,
[2]Department of Information Technology,
Amity University, Noida, INDIA

Abstract:
The purpose of the study is to enhance the research knowledge among research community. Our goal, in this paper, is to assess the state of the art of the awareness about various research terms which every student, research scholar, academician and industry professional must be sentient about. To go beyond our personal observations and opinions, we begun by surveying various students, research scholars, academicians and industry professionals who are engaged in research and asked them a series of questions on research terminology. The results of this survey gave us an idea of writing a concrete and composite article to create and clarify various issues related to research terminology. Neverthless,we hope that our attempt aids the research community.

Introduction

During the last few years, the focus on research has increased exponentially in all the fields whether it is academia, industry, higher education etc. Special targets are set each year by the universities, government and industry to have their contributions in research and development.Being academicians, the idea of writing this paper came from regular observations while interacting with students, research scholars, faculty and colleagues. It was observed that the knowledge and the information they hold about various resewarch terms was either inaccurate or incomplete. A lot of articles, papers, blogs and internet resources are written on these topics but not bundled together in a single concrete document. A description of almost all the commonly used or required terms while researching are drafted along with a short survey providing insights about the clarity of research terms among students, research scholars, academicians and industry professionals.

In this paper, we use SPSS (Statistical Package for the Social Sciences) 20.0 for data analysis of online survey done on a total of 107 students, research scholars, academicians and industry professionals. We organize the rest of this paper as follows. We start, in section 2, explaining about various research terms that are useful for every researcher. Section 3 summarizes the preliminary results of data analysis. Finally, in section 4, we conclude the paper.

1. Research Terminologies

1.1. What is Research and what it is not?

A Research is defined as an exercise that needs ample amount of time of an individual for analyzing and gauzing house of sources with the intent to offer apprehensions of the texts (Gibaldi & Franklin, 2009). The mission of a research paper is to understand and grasp what others elucidated about a topic and bring on board the presumptions in order to prudently endeavor an idiosyncratic panorama on the issue at hand and not only a cognizant outline of a subject from various resources (primary or secondary).

1.2. Research Paper

A Research paper or Academic paper or Scholarly paper is the capstone of an intricate proposition of research, captious study, source appraisement and acclimation. It transmutes with exploration, interpretation and evaluation of a specific topic and also increases the familiarity in the specific field of research. There are two major types of research papers mainly augmentative and analytical. An ***augmentative research paper*** is a prolegomenon of a particular topic chosen and informs onlookers the thesis statement he or she is interested in. The aspiration of an augmented research paper is always between sixes and sevens. This type of research paper is used to single out, scrutinize, and guesstimate by giving reasons to support or criticize something. An ***analytical research paper*** is a handiwork of reconnaissance and guesstimation (Gibaldi & Franklin, 2009). The gimmick of this paper is to censoriously elucidate primary and secondary presuppositions on the particular scrutiny of the subject.

1.3. Review paper

A Review paper or Survey paper is a study of allied work in the interested field of research, concluding with some views or knowledge of his or her own and then commenting on it. It is basically written to retrospect the ongoing amelioration of a particular topic and then summarizing by providing the findings provided in the recent research papers already available. It amalgamates the findings from literature papers and effectuates a rational opinion of the concerned topic. We need to study and analyze numerous original and relevant research papers and give our own compilations about them (Rapple, B). There are also short research contributions known as Notes with usually a single, but interesting new idea, result or innovation.

1.4. Proceedings paper

A conference is defined as the meeting of researchers, academicians, industrialists and other experts with a specialized area of interest (on which the theme of the conference is based) to discuss and present their research to each other. These papers are generally published and distributed collectively as c*onference proceedings*. You must have seen conference proceedings stacked like books in the library of your institute.

1.5. Conference Rankings

The conference ranking is basically based on its connection with the industries, the convenience of the conference location, quality of committee members and ratio of accepted papers. It is calculated by collecting information from different internet sources and academic sources. The commonly used ranking categories are represented using the below mentioned symbols along with their meaning.

Table 1: Conference rankings with their meaning

S.No.	Ranking Symbol	Meaning
1	A*	Flagship conference
2	A	Excellent conference
3	B	Good conference
4	C	Other ranked conference venues

1.6. Journal paper

A Journal paper is a peer-reviewed scholarly periodical pertinent to a certain academic field where manifestation and demonstration for investigation of neoteric research along with the elucidation of existing research is reported. A journal paper may represent a pioneer research work, review article and book review (Rapple, B). A peer-reviewed journal article is reviewed by various experts in the related field for actuality and legitimacy before being published.

1.7. Abstract

An abstract is circumscribed as an exposition of generally 150-300 words that annotate the most important points of the research paper.

1.8. Indexing

An *index* is an amassment of already written literature in a specific discipline. It is imperious for procuration along with other concepts. *The indexing* of a research paper is defined as the genesis of indexes for allowing analysts, scientists and researchers to descry information or records about a topic or field very fleetly. The Automatic Subject Citation Alert (ASCA) system facilitates the production of the Science Citation Index (Michael).

1.9. Citations

Citations are delineated as enumeration of bibliographical excerpts specifying the books, articles and other relevant sources, in a research paper generally represented by an abridged alphanumeric statement backed up in the text of a research work. A citation is a reference to a published or unpublished source combining both, citations in the main text and in the bibliography. The important purpose of citation is to uphold intellectual honesty for avoiding plagiarism (Lozano, Larivière, & Gingras, 2012). The commonly used and famous citation systems are Oxford, Harvard, IEEE, MLA, American Sociological Association (ASA) and American Psychological Association (APA). Bibliographies are generally not considered citations because these are not deliberately acknowledged by other authors. The academic citation indexes offer an index of citations between publications. It also gives a provision by which we can get the information of documents which cite any other document (s). The Institute of Science ***Index*** (***ISI***), also known as Thomson Reuters, Elsevier, Scopus, Indian Citation Index, CiteSeer, Google Scholar maintains citation databases covering thousands of academic journals

Programs exist that automatically create citations in various styles. Some of the well known citation builders are Landmark Citation Machine, KnightCite, EasyBib, Citation Builder etc.

1.10. Impact Factor and how it is calculated

Journal Impact Factor (JIF) measures the relative significance of a journal within its discipline or area, stating the average number of citations to articles published in journals, thesis, patent documents, books, project documents, newspaper articles, conference proceedings, seminar reports, internet resources and notes or any other approved document. The journals with higher impact factor reckoned to be more substantial than those with lower impact

factor (Krairiksh, 2011). Journal Impact factors can be calculated yearly/half- yearly/ Quarterly/Monthly for those journals that are indexed in Journal Reference Reports (JRR).
The impact factor is an accord of the respective dimension of the citation curve and is calculated as mentioned below.

"Impact factor equals the current citations a journal receives articles published in the two previous years (in numbers) divided by articles published in those same years (in numbers). "

So, for example, the 2011 impact factor is the citations in 2011 to articles published in 2009 and 2010 divided by the number articles published in 2009 and 2010. The resultant number can be considered as the average number of citations, the average article receives per year in the two years' post publication (Marialuisa, A.). The immediacy index gives a measure of the skewness of the curve, that is, the extent to which the peak of the curve lies near to the origin of the graph. It is calculated by dividing the citations a journal receives during the current year by the number of articles it publishes in that year, i.e., the 2011 immediacy index is the average number of citations in 2011 to articles published in 2011. The number that results can be thought of as the initial gradient of the citation curve, a measure of how quickly items in that journal get cited upon publication (Krairiksh, 2011). The cited half-life is a measure of the rate of decline of the citation curve. It is the number of years that the number of current citations takes to decline to 50% of its initial value (the cited half-life is 6 years in the example given in Figure 1). It is a measure of how long articles in a journal continue to be cited after publication.

1.11. Insight of terms used in Research community

Below text unveils the terminology used among Researchers.

1.11.1. Aims and Scope of the Conference/Journal:

The aim of the conference/journal describes the broad statement or intention of research by reflecting the aspirations and expectations of the research topic. The scope defines the extent of the area or subject matter that conference/journal is aimed at.

1.11.2. Acceptance Rate

The percentage of papers accepted by the conference or journal from the total number of submissions. Journals or conferences with lower paper acceptance rates are more prestigious and meritorious.

1.11.3. Eigenfactor

Eigenfactor score measures the journal's total importance to the scientific community. It is a calculated as the times the articles from the journal published in the past five years along with its citation in the year of calculation.

1.11.4. Article Influence Score

The article Influence score measures the average influence of the paper in the initial five years post publication. It is equivalent to Thomson Reuters's Impact Factor.

1.11.5. Society Sponsor

The sponsoring society usually responsible for financial and management issues and business policies who recognizes and accepts the journal's scientific integrity and objectivity is known as Society Sponsor. For example, IEEE Computer Society is a sponsor for several IEEE transactions and computer science conferences.

2. Results and Discussions

Data collection was done through an online survey with academicians, industry persons, research scholars and students. In total, 107 responses were obtained. Out of 107 reponses, 27 responses were obtained from industry, 34 from academicians, 23 from students and 23 from research scholars. The survey instrument consisted of ten (10) close-ended questionnaires. The aim was to check the awareness of people at various levels and industries about the basic research terminologies.

For the purpose of comparison, students and research scholars were grouped together in a single category named Student and industry and academicians were grouped in an another category Professional. This resulted in two groups, namely Professional and Student. SPSS (Statistical Package for the Social Sciences) 20.0 was used for data analysis. Appendix 1 includesfigures 1-10 representing the frequencies (in terms of percentage).
("insert figure 1-10 about here")

Further, **Mann-Whitney U test** was used to test the difference between the two groups. Appendix 2 show the results of the test. The results indicate that there is a difference in the knowledge among the two groups in terms of knowledge on conference papers and journal papers, research and review papers, peer-reviewed journal, citations of the paper, and ratings. While there is no difference in the knowledge among the two groups in their knowledge of indexing and impact factor. The median values in the table 2 of Appendix 2 show that the Student category has lesser knowledge than the Professional group. Also, for most of the values, both the groups either show an average or a below average knowledge of the research terms. This research paper thus, is a step in providing knowledge about the research terminologies to all the groups.

Appendix 3 contains a questionnaire sample which was designed to cover important terms related to research. During the initial phase of writing this paper, the questionnaire was distributed to selected students, research scholars, academicians and industry professionals. The responses for this online survey were accepted for a period of one month that resulted in 107 responses.

Acknowledgments

Authors are very thankful to Department of Information Technology and Computer Science & Engineering, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida, India for their support to carry out this study. We are also extremely thankful to all those who found time to respond to our request for their inputs.

Concluding Remarks

In this paper, we have completed a survey of investigating people from industry and academia with the purpose of analyzing the knowledge and awareness about various research terminologies. Although it is undoubtedly difficult to summarize in any complete way almost several years of research and include reference to all relevant papers in a brief document like this one. We therefore, focused on those research terms that our colleagues, students and other relevant friends and we thought were likely to be used and important. We hope that the analysis done will be thought provoking and beneficial for our interested readers. In our opinion, and from the results of the survey, we can infer that the persons designated for filling the survey have little or inaccurate knowledge of the research terminology and they surely want to seek proper guidance for improving their research knowledge.

References

1. Anika Doggett. Juvenile Delinquency and Family Structure. facstaff.elon.edu
2. Gibaldi, J., & Franklin, P. (2009). MLA Handbook for Writers of Research Papers. America: Modern Language Association.
3. Krairiksh, M. (2011). Impact Factors of International Nursing Journals, Journal of Nursing Science & Health, 34(3). Retrieved from http://patientswww.tci-thaijo.org/index.php/nah/article/view/750
4. Lozano, G. A., Larivière, V., & Gingras, Y. (2012). The weakening relationship between the impact factor and papers citations in the digital age. Journal of the American Society for Information Science and Technology, 63 (11). Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/asi.22731/pdf
5. Marialuisa, A. (n.d.). High vs. Low Impact-Factor Journals: What Difference Does It Make to Your Writing Style?. Retrieved July 16, 2012 from http://marialuisaaliotta.wordpress.com/2012/07/16/high-vs-low-impact-factor-journals-what-difference-does-it-make-to-your-writing-style/
6. Michael L. R. (n.d.). Top 20 scientific psychology journals. Retrieved September 30, 2013, from http://cogpsy.info/methods/top-20-scientific-psychology-journals/
7. Rapple,B.Writing an Education Research Paper. Retrieved May 2, 2014, from http://libguides.bc.edu/content.php?pid=1192&sid=3053190

Appendix 1

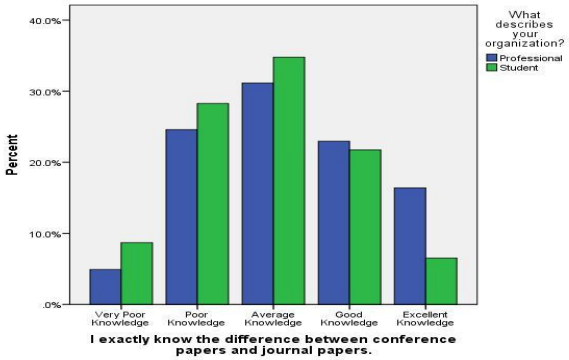


Figure 1: Relative frequency distribution showing knowledge of conference paper and journal paper (in %)

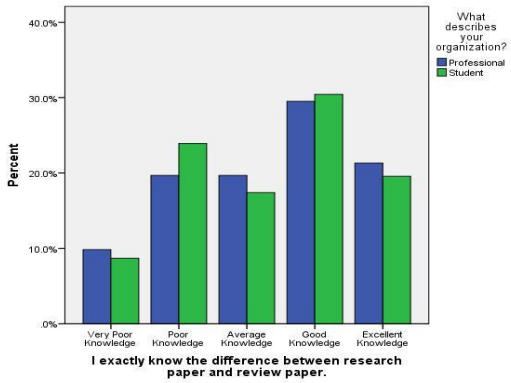


Figure 2: Relative frequency distribution showing knowledge of research paper and review paper (in %)

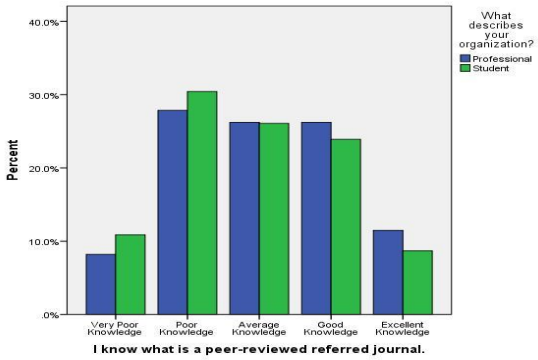


Figure 3: Relative frequency distribution showing knowledge of peer reviewed referred journal (in %)

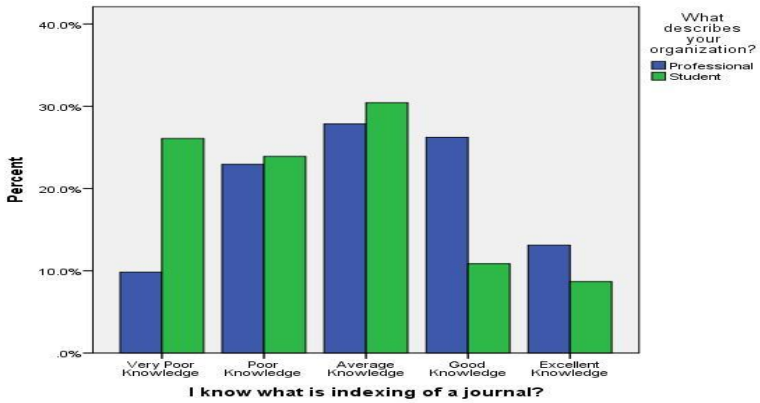


Figure 4: Relative frequency distribution showing knowledge of indexing of a journal (in %)

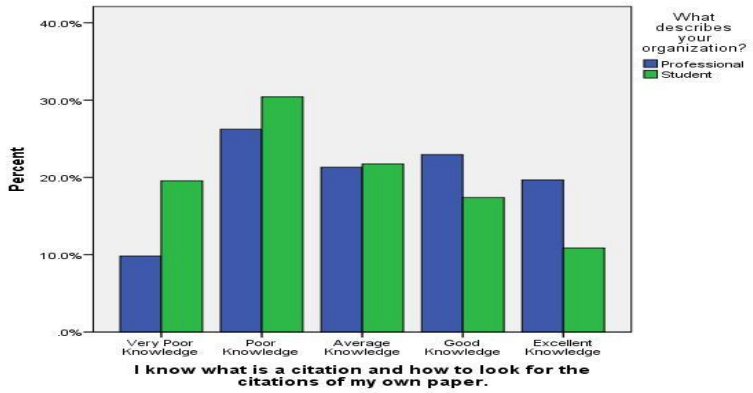


Figure 5: Relative frequency distribution showing knowledge on citations (in %)

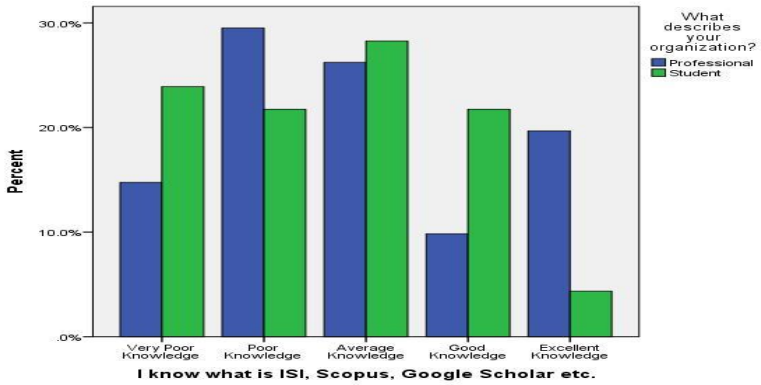


Figure 6: Relative frequency distribution showing knowledge about reputed indexing databases (in %)

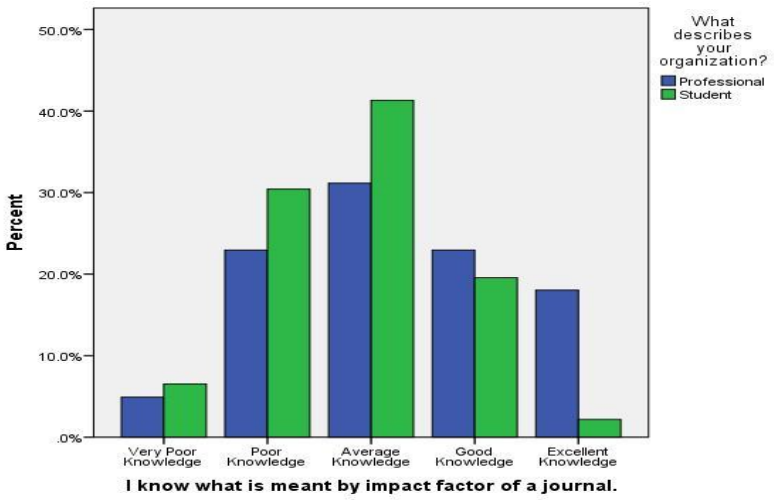


Figure 7: Relative frequency distribution showing knowledge about impact factor of a journal (in %)

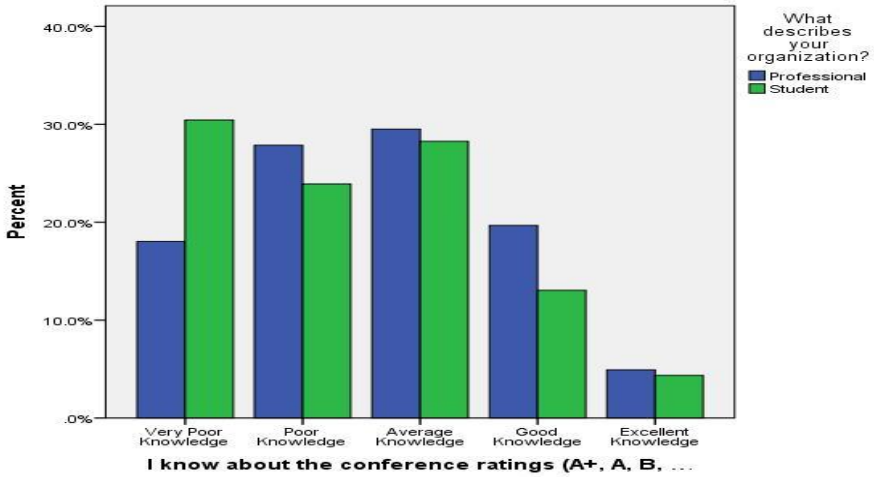


Figure 8: Relative frequency distribution showing knowledge about conference ratings (in %)

DO YOU GENERALLY FEEL THAT SOMEONE SHOULD BE THERE TO GUIDE YOU ON THE ABOVE TERMS?

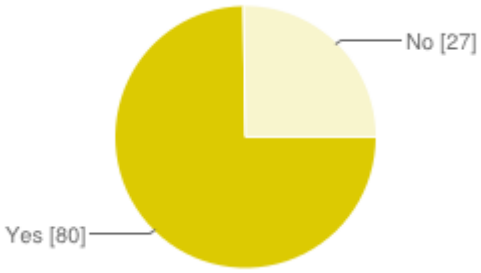


Figure 9: Frequency of people requiring guidance on the research terms

Figure 10: Frequency of factors used by researchers for research publication

Appendix 2

Table 1: Results of Mann-Whitney U test showing significant level

Test Statistics[a]								
	I exactly know the difference between conference papers and journal papers.	I exactly know the difference between a research paper and review paper.	I know what is a peer-reviewed refereed journal.	I know what is indexing of a journal?	I know what is a citation and how to look for the citations of my own paper.	I know what is ISI, Scopus, Google Scholar etc.	I know what is meant by impact factor of a journal.	I know about the conference ratings (A+, A, B, etc.).
Mann-Whitney U	1190.500	1372.500	1297.500	1031.000	1119.000	1254.500	1090.500	1203.500
Wilcoxon W	2271.500	2453.500	2378.500	2112.000	2200.000	2335.500	2171.500	2284.500
Z	-1.384	-.197	-.685	-2.403	-1.831	-.959	-2.044	-1.295
Asymp. Sig. (2-tailed)	.166	.844	.493	.016	.067	.338	.041	.195
a. Grouping Variable: What describes your organization?								

Table 2: Median values for various groups

Statistics										
What describes your organization?			**I exactly know the difference between conference papers and journal papers.**	**I exactly know the difference between research paper and review paper.**	**I know what is a peer-reviewed referred journal.**	**I know what is indexing of a journal?**	**I know what is a citation and how to look for the citations of my own paper.**	**I know what is ISI, Scopus, Google Scholar etc.**	**I know what is meant by impact factor of a journal.**	**I know about the conference ratings (A+, A, B, etc.).**
Professional	N	Valid	61	61	61	61	61	61	61	61
		Missing	0	0	0	0	0	0	0	0
	Median		3.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00
Student	N	Valid	46	46	46	46	46	46	46	46
		Missing	0	0	0	0	0	0	0	0
	Median		3.00	3.50	3.00	2.50	2.50	3.00	3.00	2.00

Appendix 3

Survey Instrument

This survey attempts to check your awareness on Research topics. Please rate yourself on the scale of 1-5 about your awareness on the Research Terms. 1 indicates Very Poor Knowledge, 2 indicate Poor, 3 indicate Average, 4 indicate Good and 5 indicate Excellent Knowledge.

*Required

1. What describes your organization? *

- ○ Industry
- ○ Academics
- ○ Student
- ◉ Research Scholar

2. I exactly know the difference between conference papers and journal papers. *

1	2	3	4	5
○	○	○	○	○

3. I exactly know the difference between research paper and review paper. *

1	2	3	4	5
○	○	○	○	○

4. I know what a peer-reviewed referred journal is. *

1	2	3	4	5
○	○	○	○	○

5. I know what is indexing of a journal? *

1	2	3	4	5
○	○	○	○	○

6. I know what a citation is and how to look for the citations of my own paper. *

1	2	3	4	5
○	○	○	○	○

7. I know what is ISI, Scopus, Google Scholar etc. *

1	2	3	4	5
○	○	○	○	○

8. I know what is meant by impact factor of a journal. *

1	2	3	4	5
○	○	○	○	○

9. I know about the conference ratings (A+, A, B, etc.). *

1	2	3	4	5
○	○	○	○	○

10. Do you generally feel that someone should be there to guide you on the above terms? *

- (•) Yes
- ( ) No

11. What are the factors you look before submitting a research paper to a journal/conference?*

- [ ] Impact factor
- [ ] Indexing
- [ ] Aims and Scope
- [ ] Publisher
- [ ] Acceptance Rate
- [ ] Editorial team
- [ ] National or International
- [ ] Publication charges
- [ ] Article Influence Score
- [ ] Eigenfactor
- [ ] Popularity
- [ ] Society Sponsor
- [ ] Past issues
- [ ] Easy acceptance
- [ ] Archives with University Affiliates
- [ ] Any Other

THE END

ARTICLE 2

ANALYSIS OF CONVENTIONAL TRANSMISSION LOSS AND DEPTH DEPENDENCE IN CONTEXT OF UNDERWATER ACOUSTIC COMMUNICATION

Manish Yadav[1], Prateek Raj Gautam[2], Sumit Dhingra[3]
[1]Assistant Professor, Apeejay Stya University, Gurgaon
[2]Assistant Professor, Allenhouse Institute of Technology, Kanpur
[3]Student, Department of EC, Apeejay Stya University, Gurgaon

Abstract:

In this paper, different factor responsible for path loss in under water acoustic communication have been identified. The paper covers important factors that may affect the quality of communication in underwater acoustic communication. These factors have significant contribution in overall path loss calculation. During the underwater communication channel performance optimization process also these factors are essential to be considered. However, the paper mainly focuses on conventional transmission loss and depth dependence in context of underwater communication in detail. Initially the different factors responsible for path loss in context of underwater communication have been identified and studied from the available literature. Then the relationship between conventional propagation loss and depth dependence has been quantified in order to analyze the path-loss in underwater acoustic communication.

Introduction

Underwater Acoustic communication refers to the process of data exchange below water [1]. In terms of general behavior, underwater acoustic waves are quite different than the radio waves travelling in an open environment. There is plenty of research work available in literature to be referred in order to study the nature and performance of acoustic waves. Significant contributions have been made [1]-[6] to explore this particular area. As described in [2], the two major loss factors obtained from the literature are geometric spreading i.e. divergence effect and absorption of acoustic signal energy by the medium itself. Apart from these two major factors, some others factors such as signal frequency (or wavelength), velocity of sound, nature and amount of impurities present in the water, local pressure variations, attenuation due to absorption and other factors, viscosity and temperature of water, size and density of air bubbles formed in water, parasite backscattered echoes and water-surface interference also affect the overall transmission loss in underwater acoustic communication. Similarly, on the basis of the capacity-based bandwidth definition, the bandwidth dependency on the distance has been shown in [3] considering physical models of acoustic propagation loss and ambient noise for in-depth analysis.

The parameters mentioned above have direct or indirect effect on underwater acoustic propagation. In order to perform the estimation of overall transmission loss, in such a scenario, all of these factors are taken into account.

Theory

While dealing with the case of underwater acoustic communication, one of the important factors that affect the quality of signal transmission is depth of the water. Here the term depth of the water resembles the depth at which acoustic signal propagation actually takes place. This depth may vary depending on the nature of water body such as sea, oceans etc. Most often in literature [1]-[6] etc. ocean and seas have been considered to apply the different propagation models. It has been described in [2] [6] that at lower frequencies, this water depth affects the entire water column and this affect is quite limited on signal propagation. However, at higher frequencies, this depth causes significant transmission loss. It is because of the fact that the absorption coefficient which is the function of frequency as described in Thorp's Model [4] also becomes the function of water depth.
The generalized mean absorption coefficient can be given as:

$$\alpha'(H) = \frac{1}{H}\int_0^H \alpha(z).dz \qquad \text{..... (1)}$$

where, z = Water depth, α = absorption coefficient H= Height above the seabed.

As mentioned in [2], the depth correction factor P_2 signifies the contribution of Magnesium Sulfate i.e. $MgSO_4$ in water. Now, assuming the dependence of P_2 on depth (z), the equation for P_2 and hence for α'(H) can be written as using Francois-Garrison Model [5]:

$$P2 = [1 - 1.37\,X\,10^{-4}\,z + 6.21\,X\,10^{-9}\,z^2] \qquad \text{..... (2)}$$

and $$\alpha'(H) = \alpha(0).A(H) \qquad \text{..... (3)}$$

where, $\alpha(0)$ = absorption value at the surface.

The value of absorption loss $A(H)$ can be given as [2]:

$$A(H) = [1 - 1.37\,X\,10^{-4}\,\frac{H}{2} + 6.21\,X\,10^{-9}\,\frac{H^2}{3}] \qquad \text{..... (4)}$$

Thus, equation (3) becomes:

$$\alpha'(H) = \alpha(0).[1 - 1.37\,X\,10^{-4}\,\frac{H}{2} + 6.21\,X\,10^{-9}\,\frac{H^2}{3}] \quad \text{..... (5)}$$

This equation (5) provides a good approximation when the salinity and temperature variations with water depth are neglected.

Assuming that the oblique distance from the source is 'R' and the standard reference range is 1 meter. Then, for spherical spreading case, informal relationship between 'R' and conventional transmission loss (TL) is given by [2]:

$$TL = 20\,log\,R + \alpha'(H)R \quad \text{..... (6)}$$

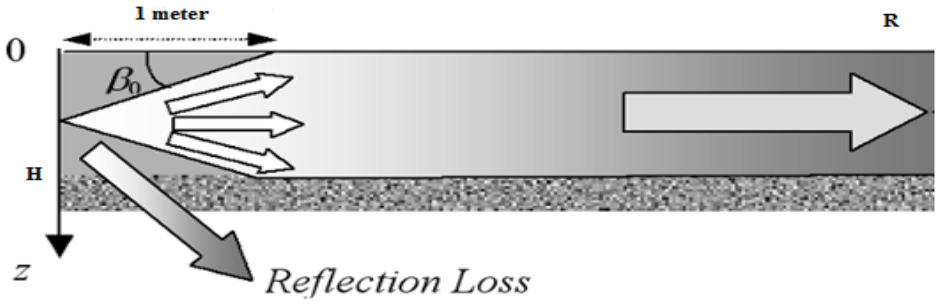


Fig 1: Energy Flux Model

Though this equation (6) is not exact but it provides a good approximation between conventional loss & depth dependence in context of underwater acoustic communication. It is important to note that the value of 'R' is usually taken in meter particularly for equation (6) but $\alpha'(H)$ is represented in dB/Km; so appropriate conversion of units in equation (6) is always desired. Total loss (for both outgoing and returning path) is given by:

$$2TL = 40\,log\,R + 2\alpha'(H)R \quad \text{..... (7)}$$

This equation (7) seems more appropriate in this context.

Performance Analysis

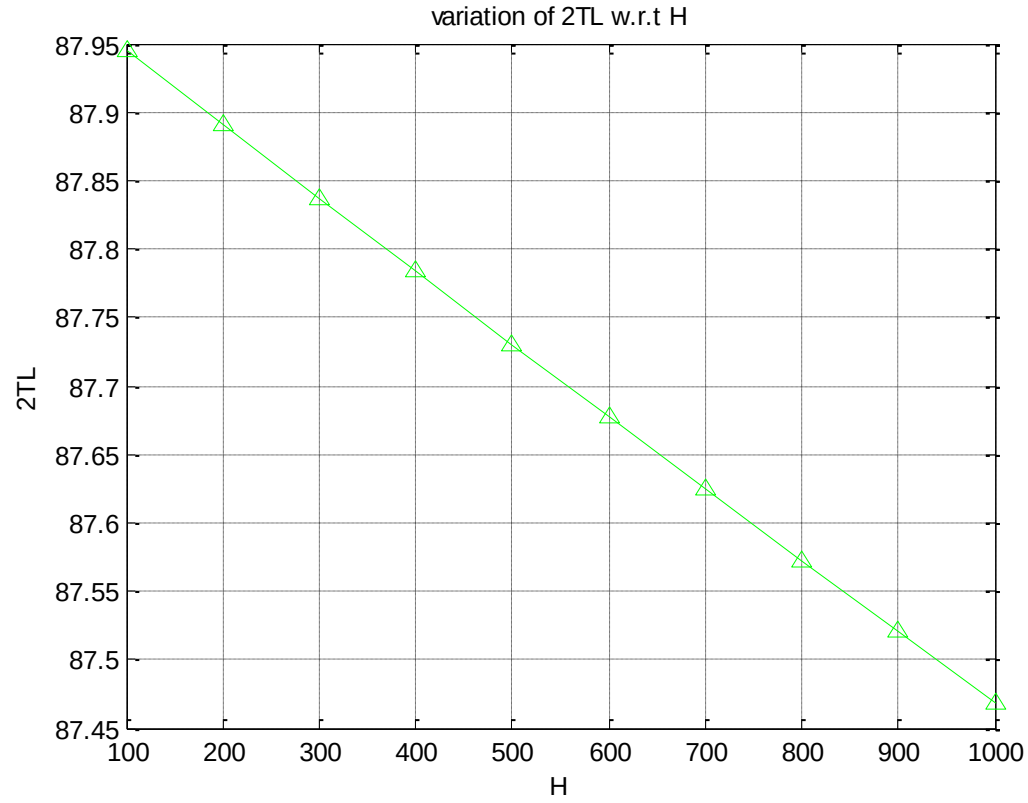
While determining the relation between the depth dependence and conventional transmission loss, parameter 'R' in equation (7) has been taken as a constant value i.e. 100 meter. At the same time, height above the seabed i.e. 'H' has been varied between 100 to 1000 meter. This performance estimation by TL measurement is purely based on the contribution of $MgSO_4$ in sea water. However, there are some other contents present in the sea water which have not been taken into account in this work. The absorption coefficient at sea surface has been taken

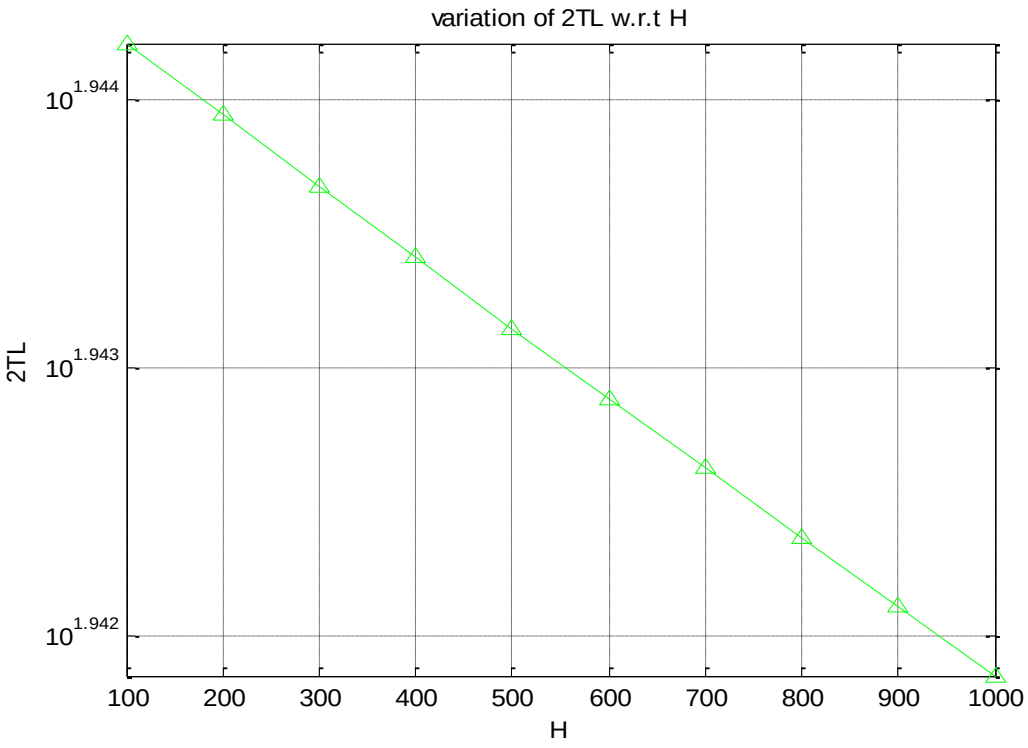
40 dB/km assuming 5^oC temperature and frequency of 100 KHz which has been calculated in [6].

In short, this can be summarized as:

SN.	Parameter Taken	Value of Parameter
1.	Frequency (f)	100 KHz
2.	Temperature (T)	5^oC
3.	Absorption Coefficient at sea surface $i.e.\ \alpha(0)$	40 dB/km
4.	Radial Distance (R)	100 meter (which is greater than standard value of R i.e.1 meter)
5.	Source Angle	Zero (in degree)
6.	Height or Depth from seabed (H)	100 to 1000 meter

Result- Following graph shows the result which has been obtained under assumed parameters from calculations.





The above graph shows the variations in conventional TL with increasing height above the sea- bed for constant R and zero degree source angle. It shows that as the value of H increases, the conventional TL due to presence of $MgSO_4$ reduces linearly assuming zero degree source angle.

Conclusion

Hence, it can be concluded that absorption and geometrical spreading are two major causes of conventional transmission loss in underwater acoustic communication. The conventional transmission loss also has depth dependence. Higher the height above the sea bed, lower the transmission loss under specified conditions. Similarly, other parameters that contribute in overall transmission loss can also be analyzed.

References

1. I. F. Akyildiz, D. Pompili, and T. Melodia, "Underwater Acoustic Sensor Networks: research challenges," Ad Hoc Networks (Elsevier), vol. 3, no. 3, pp. 257-279, March 2005.
2. Lurton, X., “An Introduction to Underwater Acoustics Principles and Applications”, Springer, ch.2, Year 2010, XXXVI, ISBN-978-3-540-78480-7.
3. Milica Stojanovic “On the Relationship Between Capacity and Distance in an Underwater Acoustic Communication Channel”, Proc. of ACM SIGMOBILE MC2R vol-11, issue-4, paper34-43, 2007.
4. L.Berkhovskikh and Y.Lysanov, “*Fundamentals of Ocean Acoustics* ” New York: Springer, 1982.
5. Francois, R. E., and Garrison, G. R., “Sound absorption based on ocean measurements, Part I: Pure water and magnesium sulphate contributions” Journal of the Acoustical Society of America, 72(3): 896–907, 1982.
6. Craig M. Payn, “Principles of Naval Weapon Systems”, ch.10, p.183, ISBN-1-59114-658-5, 2006.

THE END

ARTICLE

3

GETTING STARTED IN DOCTORAL RESEARCH: A PRIMER

Rao Mukkavilli*
Research Scholar, Manipal University, Manipal, INDIA

Abstract:

A study by Ramiro Valdez at a North Eastern School of Social Welfare found that, on a standardized scale where 100 equalled the amount of stress experienced by someone whose spouse had just died, doctoral students in their first year scored an average of 313 points. Undoubtedly, doctoral research is a very intensive and exciting pursuit with physical and mental ramifications. A researcher has to possess common sense to an uncommon degree and understand the significance of the student-advisor relationship. This is both a personal and professional relationship that rivals parenthood and marriage in its complexity, variety and leaves an indelible mark on researcher. Identifying a suitable topic which the researcher is passionate to pursue is another crucial step that needs to be worked on to produce impactful results. Research objectives should be SMART (special, manageable, achievable, reliable and timely) and if the results produced during the course of research are beneficial to mankind, would give immense satisfaction to the researcher. To reach the goal, the researcher has to remain motivated, be open minded, enthusiastic, efficient, and stay focused. This write up is a primer for all the research enthusiasts who want to shine in themselves and not outshine others.

Introduction

The mediocre can be educated; geniuses educate themselves – Condorcet
Genius is simply patience carried to the extreme – Buffon

What is research?

Medawar defined science as all exploratory activities conducted to better understand the nature and this exploratory activity is called Research. Research is a passion with intellectual challenge to learn, discover, and to change the world. Research is conducted to identify gaps in the existing knowledge, to prove what you know to be true, to disapprove what you initially believed to be true and perhaps figure out what is true.

Research requires the researcher to focus on the topic selected, to understand it completely, stick with it until researcher gets to the bottom of the research question, immerses to the point that it becomes part of life. There is no need for the researcher to be genius, but must strive to be better or unmatched by others in the chosen field. Typically, research is designed to provide new knowledge, whose findings are potentially of value to those facing similar problems elsewhere, are accessible for the benefit of all and are open for critical examination by other researchers. Research is also considered as identifying a question or questions, choosing and applying the most suitable method for collecting and analyzing the information to answer the question and disseminating the findings.

The research could be qualitative to determine why rather than how many. Quantitative research is descriptive (describe what is going on and what exists), analytical or experimental (relationship between two or more variables), causal (cause or affects one or more outcome variables) and involves observations made at one point in time or over a period of time. Any problem is interesting if studied in sufficient depth and researchers who want to make a mark for themselves must study important problems.

Are you ready to be a researcher?

Scientists and researchers, in scores of studies, have long proven beyond any doubt that practice alone makes champions in any field. Whether it's music, chess, meditation, writing, painting, programing, anything, if you put in an effort of 10,000 hours, you will become an expert in that field or in other words if you invest three hours on a daily basis for ten years, you will reach pinnacle of that skill. That's all it takes to be great at whatever you fancy. The first 1000 hours are going to be hard and even boring at times, but if you persist you'll unlock your genius and expose a creative side of you that will surprise you and everyone around you. Once you start to enjoy the process of learning or improvement, time will pass in a blink, beautifully. This is the path of perfection, of greatness, of personal fulfillment – Om Swami

Researchers are people with different temperaments and amongst them are collectors, classifiers, detectives, explorers, artists and artisans. Sir Francis Bacon suggested that people who believe they are research material actually end up depressed and dismayed. In his words "the subtlety of nature, the secret recesses of truth, the obscurity of things, the difficulty of experiment, the implication of causes and the infirmity of man's discerning power, being men no longer excited, either out of desire or hope, to penetrate further."

Hilaire Belloc wrote "Anyone of common mental and physical health can practice scientific research. Anyone can try by patient experiment what happens if this or that substance be mixed in this or that proportion with some other

under this or that condition. Anyone can vary the experiment in any number of ways. He that hits in this fashion on something novel and of use will have fame. The fame will be the product of luck and industry and will not be the product of special talent."

Research demands one to develop various skills and equip oneself appropriately to embark on the exciting and unforeseen journey. Finally, researchers should have more than one string in their bow and should be willing to take no for an answer if the evidence points that way. There is no certain way to predict in advance if the researcher's hypothesis and ideas will be fruitful. Research if done with complete sincerity is no doubt demanding but physically exhaustive and mentally rewarding.
Some people spend all at the start and finish nothing, they invent but do not progress; everything stops short of completion. The discerning should kill the prey, not spend all of his energy provoking it – Gracian

ADVISOR STUDENT RELATIONSHIP (CON(E) RELATIONSHIP)
After reviewing the research proposal, an Advisor remarked *"You are charging into a swamp, but it's your funeral"*. Researchers should be well prepared with the topic to work on with simple implementable ideas and realistic goals. The dynamics that go on in the brain of a researcher for choosing a suitable advisor are presented in **Figure 1**. Inputs by Advisor act like forest fires which are an essential for a healthy ecosystem and further growth. They rid the forest of dead wood which could otherwise serve as fuel for an even larger fire. When the fire is out, the researcher discovers a more fertile ground for new things to grow, ideas to emerge with umpteen opportunities.

BRAIN: THE MOST IMPORTANT TOOL RESPONSIBLE FOR CRITICAL THINKING AND CREATIVE THINKING
It is believed that Einstein used 17% of his brain power and on an average an individual uses only 2% of his brain. Critical thinking is considered analytical, judgmental, uses reason and logic with evaluation of different choices before making a decision. Creative thinking uses divergent thinking process to generate many ideas and the convergent thinking narrows and refines them. The frontal lobes in the brain are considered to responsible for idea generation (divergent thinking) and the temporal lobes for idea editing and evaluation (convergent thinking). Development of creative skills parallels development of one's ability to use both the left brain and the right brain that is using the whole brain. Different faculties of brain are shown in **Figure 2**.

Logical thinking versus lateral thinking: Brain functions in a characteristic way for information handling. Brain is good at establishing and creating concept patterns but not at restructuring them. Patterns are formed based on the usefulness and retain those which are necessary for survival. The selecting mechanism can only select patterns; it cannot form them or even alter them. During logical thinking, once a solution is found and considered satisfactory, researcher does not consider other options. With lateral thinking, researcher thinks out of the box and considers different options. Logical thinking uses information and moves in one direction towards the solution. In lateral thinking researcher uses information to evaluate options and works in multiple directions with entirely different possible outcomes. The key differences between logical and lateral thinking are shown below.

Logical Thinking	Lateral Thinking
Selective	Generative
Rightness	Richness
Moves in a particular direction	Generates a direction
Analytical	Provocative
Sequential, one has to be correct at every step	Can make jumps, no need to be correct at every step
Excludes irrelevant information	All information is welcome
Categories, classifications and labels are fixed	Nothing is labeled and fixed
Follows well-trodden path	Explores least likely path

How to apply logical and lateral thinking in research? A problem is simply the difference between what one thinks and how he plans to achieve it. Some problems are addressed by having more information/literature search, rearrangement of information already available/connecting dots and it is considered a problem but is not a problem. The first type of problem can be solved by logical thinking but for others stated above, lateral thinking can be pursued.

How to maximize power of brain as suggested by Cajal: The forging of new truth almost always requires severe abstention and renunciation. Most researchers lack self-confidence and are unaware of the power of single minded devotion. This kind of concentration over a period of time refines the observation power, enriches analytical skills and spurs imagination. By focusing all the energies on the problem being studied, new frontiers of research will open. During the preparation period, a researcher should avoid all the earthly matters unrelated to his research topic.

CLASSIFICATION AND CHARACTERISTICS OF HIGHLY CREATIVE AND SUCCESSFUL RESEARCH INDIVIDUALS

Nowadays creativity is being regarded as the most important factor for innovation and progress. The most effective way of generating ideas and being creative is to rearrange the available information. With democratization of knowledge through internet, the only parameter that is making the difference is creativity. Creativity is nothing but the way we use our mind in storing, processing and retrieving the information. Lateral thinking helps in this aspect. It helps in generating new ideas and looking beyond the usual. Both lateral and logical thinking are necessary, as lateral thinking provides the ideas and logical thinking develops it. Creative individuals are classified as interpersonal, intrapersonal, vocalists, mathematical, musical, naturalistic, spatial and kinesthetic. A researcher should have a flavor of all these creative attributes mentioned below to develop an amazing personality.

1. Very accurate self-perception: Focussed researchers have high level of curiosity, energy and specialized knowledge. Mulling over a research topic with intensity help and can view an issue from different perspectives. If a researcher goes to bed thinking on a problem, by morning will have many probable leads/ ideas to work on.

2. Ability to gel with any individual and in any situation effectively: It is important to not only know the people in your field but having contact with experts in other fields also. They inspire and often lead to new ideas or solution to the issues that are currently plaguing the researcher. A good researcher has a brain map to integrate different pieces of information to his advantage. A researcher takes criticism or opposite views in his stride and uses it for his betterment.

3. Ability to think clearly and present elegantly complex research ideas. Command over language gives an ability and edge to share ideas and display personality. It helps the researcher during presentations and publishing the research work.

4. Ability to proactively plan, take calculated risks and persist in failures. If the results are as expected or totally unexpected, both scenarios open gates for further research. In research, the unexpected results may be more useful and worth investigating than the expected results.

5. Pictorial representation of data: A researcher work on different projects at a time and simplify the data by creating visual maps. A picture speaks thousand words and all complex ideas can be summarized at one place.

6. Aware of latest developments in the field and ready to pass on the baton: Coaching another person actually makes the researcher an expert in the process. A researcher's research is not successful until he coaches another researcher to become one.

STEPS IN RESEARCH

A little each day is enough, as long as a little is produced each day – Payot

These are typical steps a researcher follows during research work.

1. Identification of Research Question - Literature search – Choosing a topic which is a passion.

If we discover ourselves surrounded by a number of equally promising and fertile problems to work on, choose the one whose methodology we understand clearly, and the one we have a decided liking for. Our intellect redoubles its efforts when perceiving the reward of pleasure or utility in the distance. – Darwin

A researcher should know, what is the current state of research in the field, what are the experts doing in this field today and what sort of edge researcher has, what are the gaps in the field of research and their need. Don't just ask the obvious questions. Look deeper and don't be afraid to rethink basic fundamentals about your research hypothesis.

The most important quality of the scholar is originality, that is, the ability to picture something beyond what is taught. Precision in one's work, self-criticism, conscientiousness, knowledge, and skill are also necessary, but all can be acquired later through suitable education. – Ostwald

An idea is often disapproved at first (no market value) but once it becomes acceptable starts to sell at high market price.

2. Develop Testable Hypothesis

He who refuses hypothesis as a guide is resigned to accept chance as a master – Le Blon
The intensity of the conviction that a hypothesis is true has no bearing on whether it is true or not – Medawar

A hypothesis is a prediction and is considered to be true until proven otherwise, if brief is twice good, as fewer words in will mean less litigation. Hypothesis should be easily understood and propose new arguments with likely outcomes. Even if there is no successful outcome initially, hypothesis helps in working in the right direction.

3. Proactively Plan Resource Allocation and Design of Studies to Establish Facts

A researcher has to upfront plan for resources required for successful completion of the project and accordingly organize them. Inductive studies are focussed on making broader conclusions from specific observations and in deductive studies, researcher works from general to specific. Plan initial experiments which will yield positive results to gain the confidence and are less resource intensive. Failures in research can be costly and time consuming and is necessary evil as without it no learning will really come. Rather than eliminating failure, focus on reducing the cost of failure.

Chance smiles not on those who want it, but rather on those who deserve it. It is important to recognize that only the great observers' benefit from chance because only they know how to pursue it with the necessary strength and perseverance – Ducalux

4. Execution

Use of appropriate and state of the art analytical procedures, data collection procedures, generating results which are reliable and reproducible, perform data analysis, draw conclusion of analysis, describe the significance of research which arouse scientific curiosity and opportunities to advance further knowledge, communicate research findings in the form of publications and presentations, ability to write proposals for funding opportunities to promote scientific, personal and professional growth. Connect the varied concepts, ideas and theories from previous experiences, change the order of experiments, test strategic assumptions than logical ones. Give form to your idea as quickly as possible and begin testing it right away. This is the only way to know if you've touched on something truly promising.

5. Learning

Researchers should strive for original ideas, have good experimental hand, fluency over the subject and language, tolerance to unforeseen bottlenecks, setbacks and resistance to premature closure of topic of interest. *Pasteur quoted "fortune favors the prepared mind" and Fontenelle added "strokes of good fortune are only for those who play well".*

6. Decisive call: Misplaced assumptions may cost money and time. It is better to decide fast and dump the idea.

Righteousness is the accordance of actions with what is right. In all things success depends on previous preparation; without such preparation there is failure – Confucius

RESEARCH ALLIANCES

A researcher has to be highly enterprising in networking with other well-known and established scientists in the chosen field of research. It further helps the researcher to keep himself abreast with the latest developments in the chosen field by being part of organizing committee for a conference or at least attending it. Publications in journals with high impact factor add credibility to the research work and show that the researcher is mature and understands the nuances.

Research alliances offer win-win situation as both sides bring strengths, importance of research topic and how crucial it is address it under the current scenario, interdependence with complementary skill sets, seamless flow of information, integration of resources, integrity in reporting of data with cross verification and investment with stake in the collaborator's success.

TIPS TO RESEARCHERS BY DISTINGUISHED SCIENTISTS

Saintly may emerge from the docile and humble, but rarely scholars - Cajal

Cajal, Nobel Laurate, believed that discovery is an indescribable pleasure which pales the rest of life's joys. He believed that to become great scholar, a researcher should have unwavering devotion to truth and a passion for impeccable reputation. Further Cajal believed, great scientific undertakings require intellectual vigor, as well as severe discipline of the will and continuous subordination of all one's mental powers to an object of study.

Cajal believed that none of the scientist arrived late for certain problems; as we are also born too early to help solve others. He felt a beginner to accept the role of gathering details that escaped the wise discoverer and assured that those who are open minded will eventually acquire an analytical sense so discriminating, and powers of observation so keen, that they will be able to solve important problems successfully. Independence of judgment is crucial to be a successful researcher. A researcher should study the previous research carefully and question the work of their predecessors and mentors.

- Qualities: devotion to truth, independent judgment, high level of curiosity, undying perseverance and passion for reputation.
- Real passion: works for the benefit of humanity in making the life more comfortable, to reduce struggle, suffering, pain.
- Above and beyond: researcher should be unconcerned with the pettiness shown by others and trifles of everyday life. For a true researcher, it is important to find the truth and establish the facts.
- Focus: it is better to focus on one or at the most two topics to work on. It helps in conserving the brain power than dissipating it with many details. Human brains like desert palms, pollinate themselves at a distance.
- Humility: fruit always comes after the realization of love. So it is better to start as a bench worker and later graduate to being the thought leader in the chosen field.
- Strength: in research means are virtually nothing but researcher is everything and with enthusiasm and perseverance can work miracles. There is poverty of will rather than lack of means.

James Watson of DNA double helix fame believed that to succeed in science, a researcher needs lot more than luck, as it's not enough to be smart, as lots of people are smart and get nowhere in life. He gave few rules for researches and asked to combine intelligence with a willingness to not follow conventions when they block the way forward.

- Learn from the winners and associate yourself with achievers
- Take risks in which you believe in
- Have a plan B and always have someone who will save the day for you
- Have fun, stay connected, enjoy the work – never do anything that does not make you happy.
- If you can't stand your real peers, get out of science. It is very hard to succeed in science if you don't want to be with other scientists. A scientist who is too cagey or suspicious to tell and discuss with his colleagues and peers anything will soon find that no learning is happening in return. A researcher who wishes to keep friends must not criticize other researchers work but get motivated to do something different.

Torrance, a creative mentor gave the following rules

- Find a teacher or mentor who will help you
- Fall in love with something and pursue it with intensity
- You will do best in what you like to do the most

- Know, understand, take pride in, practice, develop, use, exploit and enjoy your greatest strengths
- Learn to free yourself from the expectations of others and to walk away from the games they try to impose on you
- Free yourself to play your own game in such a way as to make good use of your gifts
- Learn the skills of interdependence to share your greatest strengths and most intense ones
- Don't try to do everything, do what you can do well and what you love to do

de Bono proposed six thinking hats to critically review a question and to come up with suitable solutions. These colored hats are

- Blue hat: Overall control, management of thinking process
- White hat: Gathering information known or needed
- Rat hat: Feelings, emotion and intuition due to the information
- Green hat: Creativity with convergent and divergent thinking
- Yellow hat: Evaluating for value and benefit
- Black hat: Looking for traps or show stoppers

Everybody has gone to boundary but nobody has crossed it, I sleep in the vast expanse beyond the boundary - Kabir

Figure 1: Advisor-Researcher Dynamics

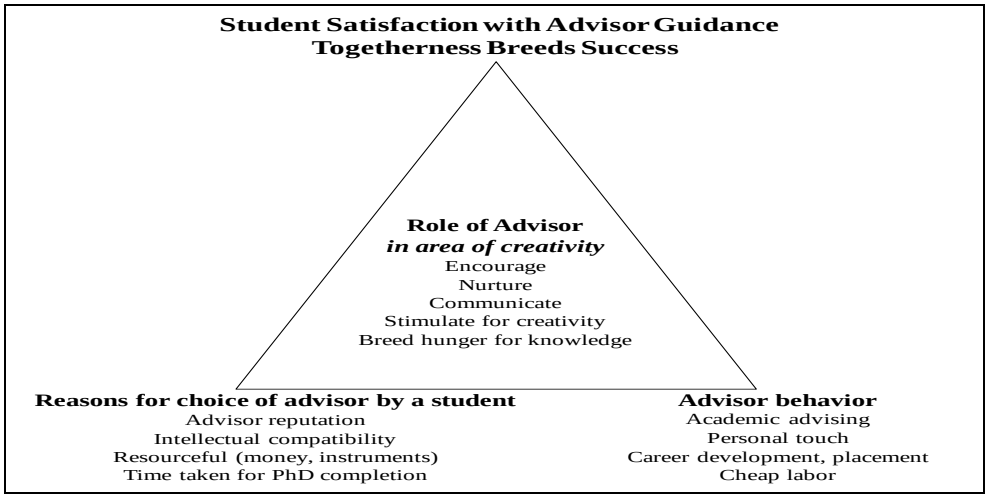
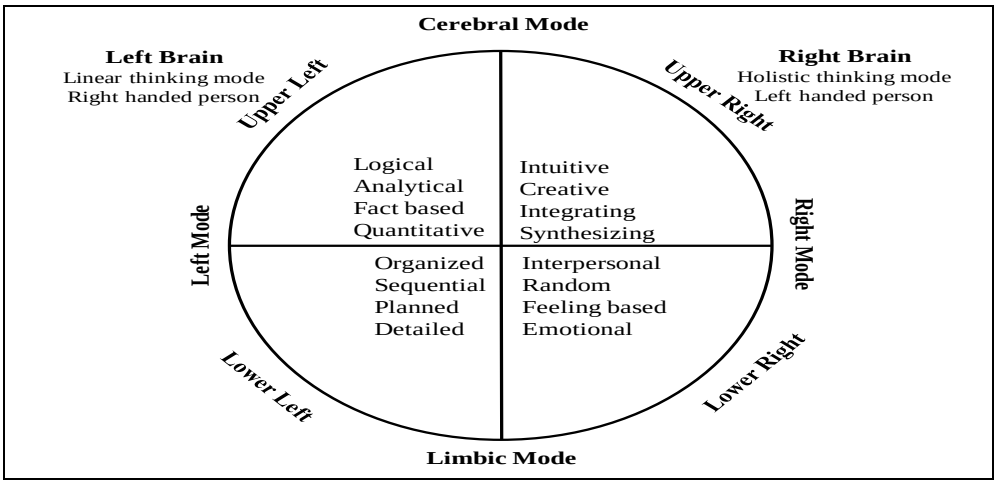


Figure 2: Holistic thinking brain



CONCLUSIONS

Every game is played a certain way and has its own rules. A researcher should have lots of cultural capital and carry the map of learning to learn fast and effectively from the habitus and conduct oneself as *fish in water*. A researcher needs to first observe, learn the rules and subsequently learn to play and eventually become an expert at it. Once a researcher becomes a thought leader in the chosen field, ends up setting the rules. By virtue of it, he attracts the best talent which further acts as a fuel to propel the research.

The die is cast and with this I finish my book, caring little whether it is read today or by posterity. Someday there will be readers. After all, did god not wait six thousand years to find in me a beholder and interpreter of his works - Kepler

ACKNOWLEDGEMENTS

The author would like to thank all his mentors. The notes compiled here are collected over a period of time and may have been reproduced verbatim. Apologize to all researchers if in-advertently failed to acknowledge them in the references.

References

1. Bono ED. 1970. Lateral Thinking. Penguin Books
2. Biomedical Research – From Ideation to Publication. 2010. Eds. Jagadeesh G., Murthy S, Gupta YK, Prakash A. Wolters Kluwer
3. Cajal SR. 1999. Advice for a young investigator. A Bradford Book. The MIT Press, Translated by Neely Swanson and Larry W. Swanson
4. Ehrlich B. 2010. The portrait of a scientist as a young artist. The Beautiful Brain. 1-8
5. Torrance EP. 1993. Understanding creativity: Where to start? *Psychological Inquiry*. 4(3): 232-234
6. Medawar RB. 1979. Advice to young scientist. Harper Colophon Books
7. Watson J. 1993. Succeeding in science: some rules of thumb. 261: 1812-1813

THE END

ARTICLE 4

ANALYSIS OF INDIVIDUAL AND BACTERIAL CONSORTIUM OF BROTH CULTURE OF PSEUDOMONAS AERUGINOSA, SERRATIA MARSCECENS AND BACILLUS SUBTILIS TO EMULSIFY OILS AND HYDROCARBONS

Jyotsna Kiran Peter*, Abhishek Kumar Rao & Ritu Kumari
Department of Microbiology and Fermentation Technology, Jacob School of Biotechnology and Bioengineering, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad, INDIA

Abstract
Three bacteria namely, *Pseudomonas aeruginosa*, *Serratia marscecens* and *Bacillus subtilis* were screened for biosurfactant activity and consortium was formed to examine the emulsification of oils and hydrocarbons. The bacteria and consortium showed positive blood hemolytic and lipase activity. The bacteria and consortium was able to emulsify vegetable oil effectively as compared to hydrocarbons viz. petrol, Diesel, kerosene and mobil oil.

Introduction

Microorganisms exhibit emulsifying production by producing biosurfactants and utilize hydrocarbons as substrate often mineralizing them or four different oils as substrate and the biosurfactant converting them into harmless products (Priya and Usharani, 2009). Biosurfactants are metabolites, generally secondary, that constitute a group of diverse compounds synthesized by a wide variety of microorganisms (bacteria, filamentous fungi and yeasts) (Rodríguez *et al.,* 2010; Cameotra and Makkar, 2004; Nitschke *et al.,* 2005; Banat, 2010).

Biosurfactants are microbially produced surface-active agents and occur in nature as chemical entities such as glycolipids, phospholipids and lipopeptides. These molecules have attracted considerable scientific attention due to lower toxicity, higher biodegradability, activity at extremes of temperature, pH and salinity and possibility of their production through fermentation using cheap agro-based substrates (Desai and Banat, 1997; Sen *et al.,* 2009). They have the unique property of lowering the interfacial tension between two liquids. Biosurfactants act on the interface and are amphipathic molecules with both hydrophilic and hydrophobic moieties present within the same molecule (Sekhon *et al.,* 2011). In addition biosurfactants have a huge repertoire that enables them to degrade a wide range of organic pollutants (Magdalena *et al.,* 2011). The prospects of biosurfactants have a great potential because of their applications in the petroleum industry (Mulligan, 2005; Banat, 1995; Amedea *et al.,* 2010) and microbial enhanced oil recovery (Okpokwasili and Ibiene 2006; Youssef *et al.,* 2007; Salehizadeh and Mohammadizad, 2009; Amani *et al.,* 2010; Shavandi *et al.,* 2011; Darvish *et al.,* 2011). The *Rhodococcus ruber* biosurfactants are found to be 1.4 to 2.3 times more efficient then the synthetic surfactants (Tween 20, Tween 60) in enhanced crude oil desorption and mobilization from soil core, with 65-82% crude oil recovery (Philip, 2005). Moreover, esterases and lipases show activity on a great variety of substrates, with no requirement for added cofactors (Schmidt-Dannert, 1999). Thus, they are very interesting biocatalysts for industrial purposes such as detergency, flavor production, paper recycling, chemical synthesis and resolution of racemic mixtures (Jaeger *et al.,* 1999).

The present work is an initial attempt to systematically screen for biosurfactant-producing microorganisms and to evaluate their emulsification activity.

Materials and Methods

A. Screening of isolates for biosurfactant activity

Cells in the flasks were harvested by centrifugation at 6000rpm for 15 minutes and the supernatant was used as the biosurfactant solution. The test for determines the potency of the biosurfactant was based on the following (Umeji *et al.,* 2010).

B. Haemolysis on Blood Agar

Blood hemolysis was screened by plating cells on Blood Agar plates containing 5% (v/v) sheep blood/human blood and incubated at room temperature for 24 hours. Haemolytic activity was detected by occurrence of a defined clear zone around a colony which was an indicative of biosurfactants activity.

C. Drop Collapse assay

Petrol/Diesel oil (2µl) was added to petriplate lid. The lid was pre-equilibrated for 1 hour at room temperature, and then 5µl of the culture supernatant was added to the surface of oil. The shape of the drop on the oil surface was inspected after 1 minute. Biosurfactant containing cultures will give flat drops, thus indicating a positive result.

D. Lipase assay

Tributyrin agar plates were prepared using Nutrient agar and Tributyrin (1%). The pH of the medium was adjusted to 7.3 - 7.4 using 0.1 N NaOH. The culture was streaked on the Tributyrin agar plates and incubated at 28°C for 7 days. The plates were then examined for zone of clearance around the colonies.

E. Emulsification index

Sterile biosurfactant solution (2ml) was added into each test-tube (in a set of three) containing the substrate (Petrol/Diesel) 2ml. The content of the tubes was vigorously shaken for uniformity for 2 minutes and left undisturbed for 24 hours. The volume of oil that separated after 24h, 48h and 72h of standing was measured that showed the ability of a molecule to form a stable emulsion. The emulsification activity was defined as the height of the emulsion layer divided by the total height and expressed in percentage.

$$E = \frac{\text{Height of the emulsion layer}}{\text{Total height}} \times 100$$

Where,

- E_0=emulsification index at 0h.
- E_{24}= emulsification index after 24h.
- E_{48}=emulsification index after 48h.
- E_{72}= emulsification index after 72h.

RESULTS

F. Blood hemolysis assay by isolates

Pseudomonas aeruginosa showed α hemolytic pattern on blood agar medium while *Serratia marscecens* and *Bacillus subtilis showed* β hemolysis. Blood hemolysis assay indicates a role of hemolysis caused by biosurfactant producing micro organisms that has been reported in several earlier literatures.

Table: 1 Blood hemolysis assay by isolates

Biosurfactants source	Blood hemolytic pattern
Pseudomonas aeruginosa	**A**
Serratia marscecens	**B**
Bacillus subtilis	**B**
Consortia	**B**

G. Lipase activity of consortia and individual bacteria

All three bacterium showed a positive lipase activity on Tributyrin agar plates as well as the consortium was able to hydrolyze lipid.

Table: 2 Lipase activities of consortia and individual bacteria

Biosurfactants source	Petrol	Diesel	Mobil oil	Kerosene	Mustard	Soybean	Jasmine	Almond
Pseudomonas aeruginosa	+	+	+	+	+	+	+	+
Serratia marscecens	+	+	+	+	+	+	+	+
Bacillus subtilis	+	+	+	+	+	+	+	+
Consortia	+	+	+	+	+	+	+	+

H. Emulsification index of *Serratia marscecens* culture in BH broth

Broth culture of *Serratia marscecens* showed highest emulsification in mobil oil (50%) that was stable till 96h of incubation (29.16%). It also emulsified diesel with stability till 96h as29.16%, 22.22, 20.83, 17.39 and 13.63. Kerosene was emulsified till 24h of incubation while there was no emulsification of petrol. Among vegetable oils coconut oil was highly emulsified with stability till 96h. Mustard oil, jasmine and soy bean oil were also emulsified having stability till 96h of incubation. Comparatively the broth culture was found to effectively emulsify vegetable oil as to that of hydrocarbons.

Table: 3 Emulsification index of *Serratia marscecens* culture in BH broth

	Emulsification index of *Serratia marscecens* culture in BH broth					
	Substrate	E0	E24	E48	E72	E96
Hydrocarbons	Kerosene	11.53	9.094	4	0	0
	Petrol	0	0	0	0	0
	Diesel	29.16	22.22	20.83	17.39	13.63
	Mobil oil	50	40.9	40	36	29.16
Vegetable oils	Mustard oil	40	30.76	34.37	32.25	30
	Coconut oil	60	54.16	50	47.82	45.45
	Soy bean oil	45.83	43.75	35.71	28.57	23.07
	Jasmine oil	53.84	52	46	44	41.66

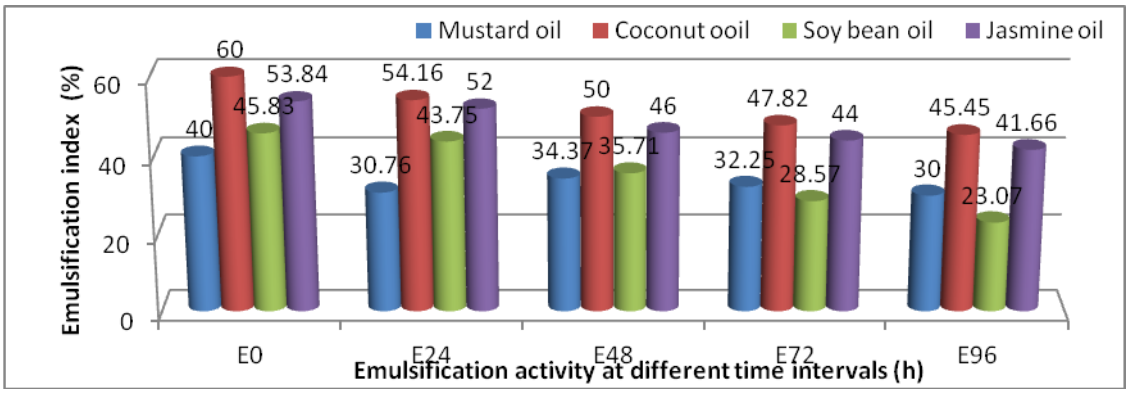


Fig:1 Emulsification index of *Serratia marscecens* culture in BH broth

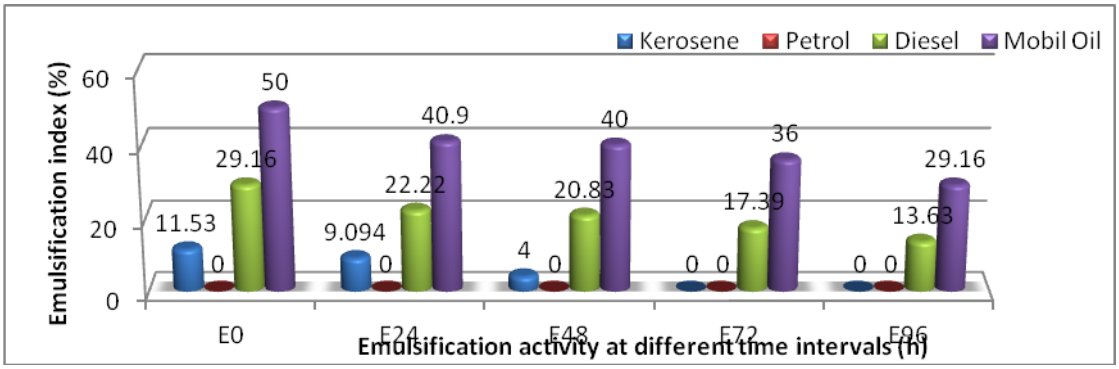


Fig:2 Emulsification index of *Serratia marscecens* culture in BH broth

I. Emulsification index of *Bacillus subtilis* in BH broth

Broth culture of *Bacillus subtilis* showed highest emulsification in mobil oil (76.92%) that was stable till 96h of incubation (33.33%). It also emulsified diesel with stability till 96h as 53.84%, 52%, 46.15%, 45.83% and 42.85%. Kerosene was emulsified as 28%, 25%, 20%, 12.5% and 9.69% while for petrol emulsification was as followed 45.45%, 42.1%, 40%, 38.88% and 35.29%. Among vegetable oils jasmine was highly emulsified (76.92%, 75%, 68%, 58.33% and 54.16%) with stability till 96h. Mustard oil, jasmine and soy bean oil were also emulsified having stability till 96h of incubation. Comparatively the broth culture was found to effectively emulsify vegetable oil as to that of hydrocarbons.

Table: 4 Emulsification index of *Bacillus subtilis* in BH broth

	Emulsification index of *Bacillus subtilis* in BH broth					
	Substrate	**E_0**	**E_{24}**	**E_{48}**	**E_{72}**	**E_{96}**
Hydrocarbons	**Kerosene**	28	25	20	12.5	9.69
	Petrol	45.45	42.1	40	38.88	35.29
	Diesel	53.84	52	46.15	45.83	42.85
	Mobil oil	76.92	62	48	37.5	33.33
Vegetable oils	**Mustard oil**	75.86	68	68.96	67.85	66.66
	Coconut oil	42.85	41.66	37.03	33.33	30.76
	Soy bean oil	58.62	57.14	53.84	52	50
	Jasmine oil	76.92	75	68	58.33	54.16

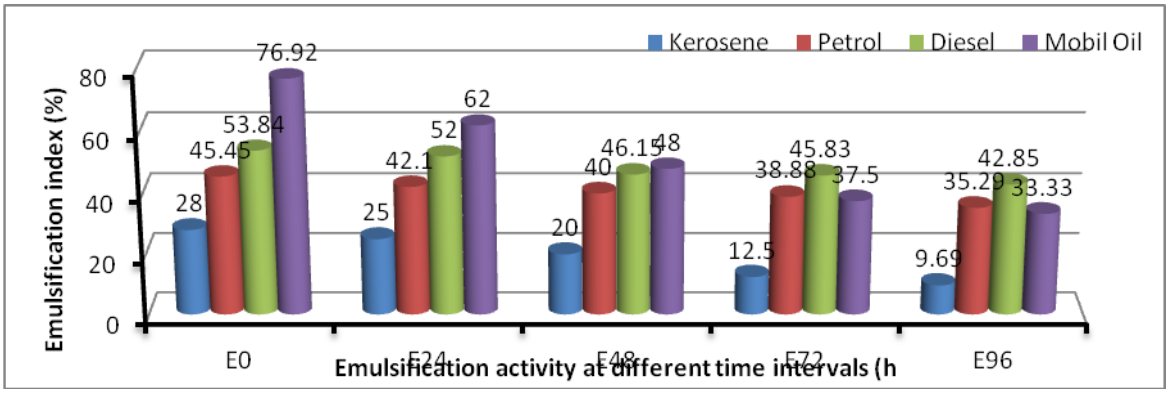


Fig:3 Emulsification index of *Bacillus subtilis* in BH broth

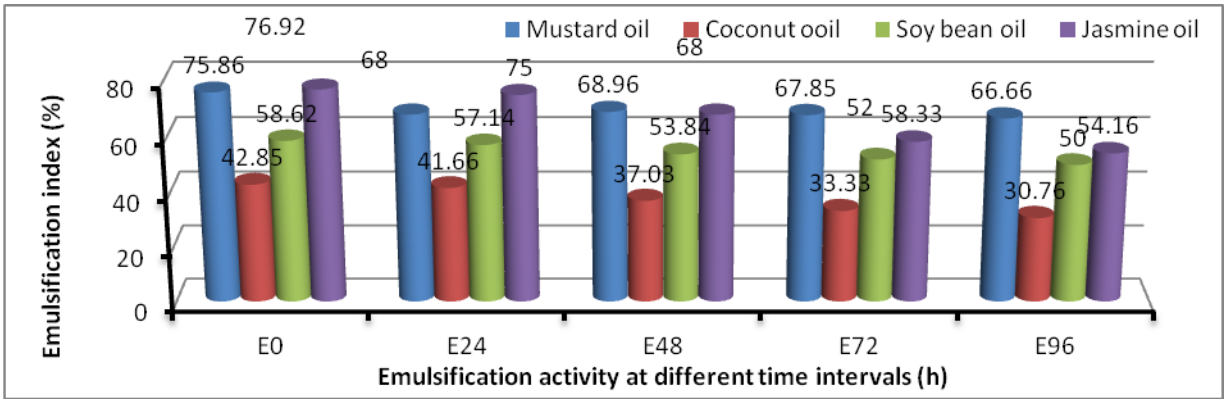


Fig:4 Emulsification index of *Bacillus subtilis* in BH broth

J. Emulsification index of *Pseudomonas aeruginosa* in BH broth

Broth culture of *Pseudomonas aeruginosa* showed highest emulsification in mobil oil (50%) that was stable till 96h of incubation (29.16%). It also emulsified diesel with stability till 96h as 88%, 64.28%, 50%, 47.82% and 45.45%. Petrol was emulsified till 24h of incubation while there was no emulsification of Kerosene and diesel oil. Among vegetable oils mustard oil, was highly emulsified with stability till 96h. Coconut oil, jasmine and soy bean oil were also emulsified having stability till 96h of incubation. Comparatively the broth culture was found to effectively emulsify vegetable oil as to that of hydrocarbons.

Table: 5 Emulsification index of *Pseudomonas aeruginosa* in BH broth

	Emulsification index of *Pseudomonas aeruginosa* in BH broth					
	Substrate	**E_0**	**E_{24}**	**E_{48}**	**E_{72}**	**E_{96}**
Hydrocarbons	**Kerosene**	0	0	0	0	0
	Petrol	9.52	5.55	0	0	0
	Diesel	0	0	0	0	0
	Mobil oil	88	64.28	50	47.82	45.45
Vegetable oils	**Mustard oil**	79.31	60.71	57.14	55.55	53.84
	Coconut oil	48	47.82	47.82	45.45	42.85
	Soy bean oil	48	47	41.66	40.9	40
	Jasmine oil	54.54	52.38	45.45	45	38.88

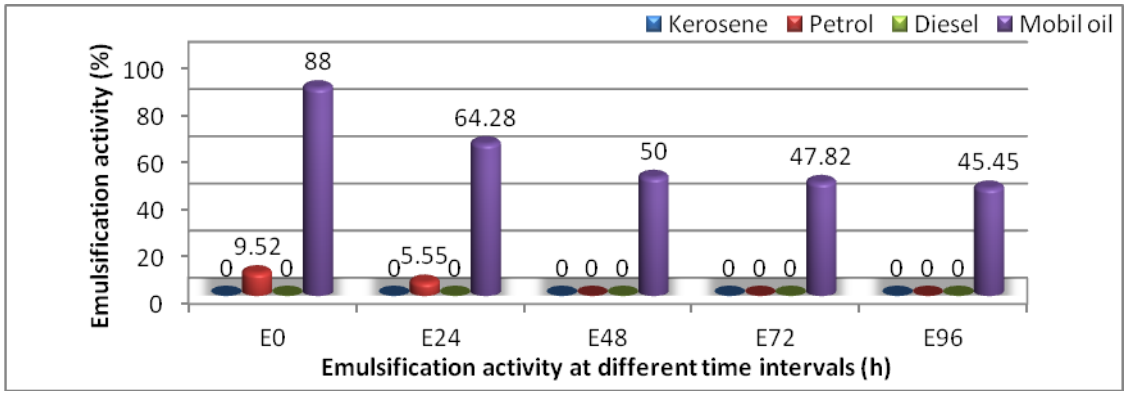


Fig:5 Emulsification index of *Pseudomonas aeruginosa* in BH broth

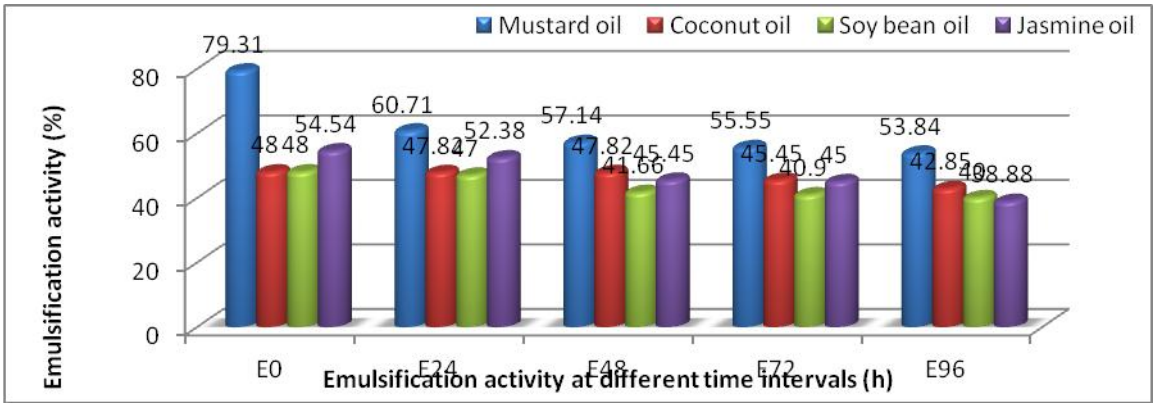


Fig:6 Emulsification index of *Pseudomonas aeruginosa* in BH broth

K. Emulsification index of consortium in BH broth

Broth culture of consortium showed highest emulsification in mobil oil (88%) followed by petrol that was stable till 96h of incubation (78.26%). Bacterial consortium was not able to emulsify Diesel and kerosene. Among oils jasmine was highly emulsified folloed by coconut mustard and soy bean oil. Comparatively the broth culture was found to effectively emulsify vegetable oil as to that of hydrocarbons.

Table: 6 Emulsification index of consortium in BH broth

	Emulsification index of consortium in BH broth					
	Substrate	**E_0**	**E_{24}**	**E_{48}**	**E_{72}**	**E_{96}**
Hydrocarbons	Kerosene	0	0	0	0	0
	Petrol	40.9	34.78	30.43	22.22	13.33
	Diesel	0	0	0	0	0
	Mobil oil	88	81.81	80	79.16	78.26
Vegetable oils	Mustard oil	35.48	33.33	30	20.68	17.85
	Coconut oil	42.3	37.03	32	29.16	25
	Soy bean oil	16	13.04	8	4.16	0
	Jasmine oil	48	47.82	40	34.78	33.33

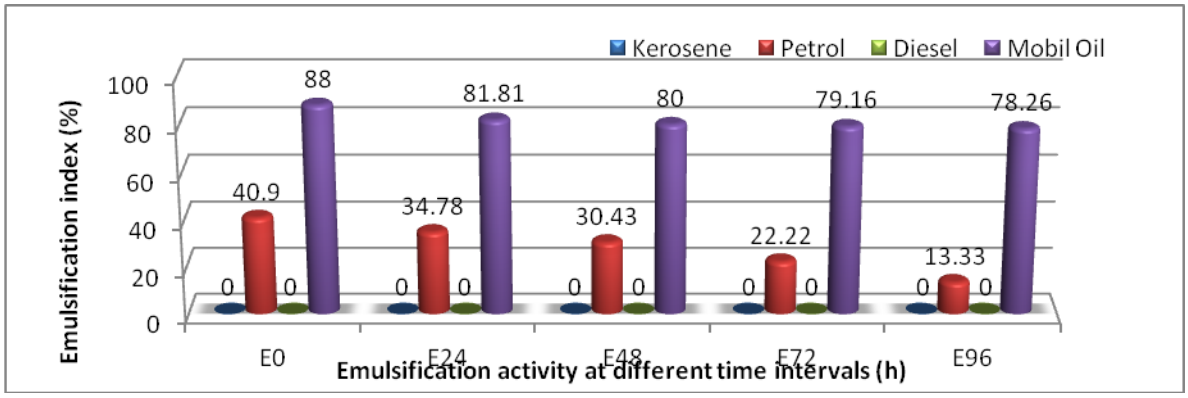


Fig:7 Emulsification index of consortium in BH broth

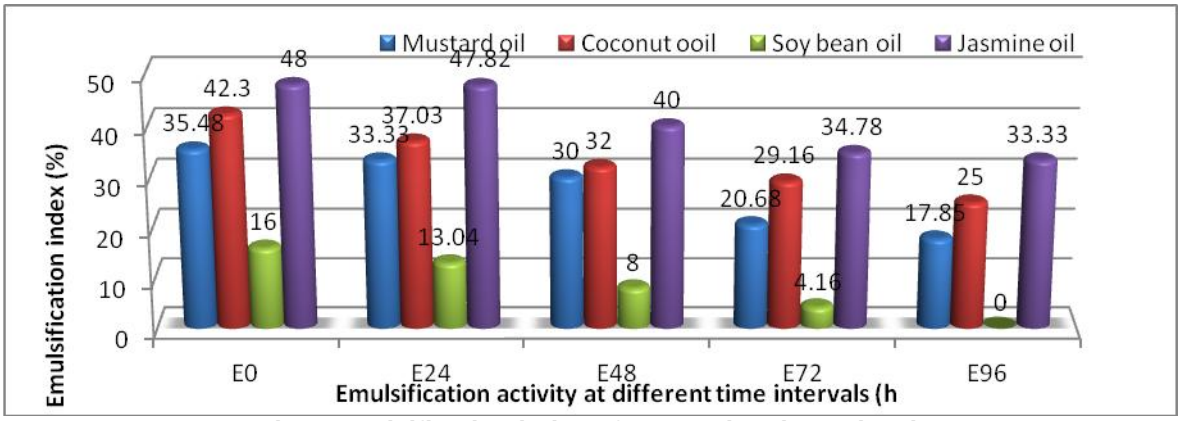


Fig:8 Emulsification index of consortium in BH broth

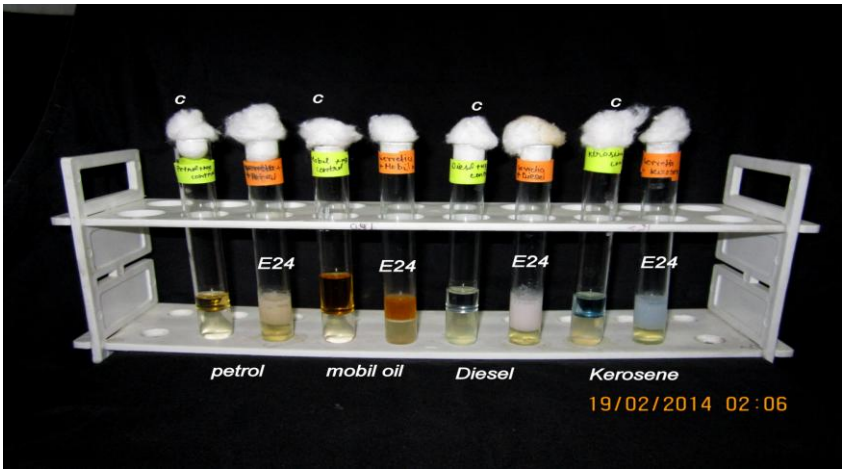


Plate: 1 Emulsification activity of cells of *Serratia marscecens* in BH broth

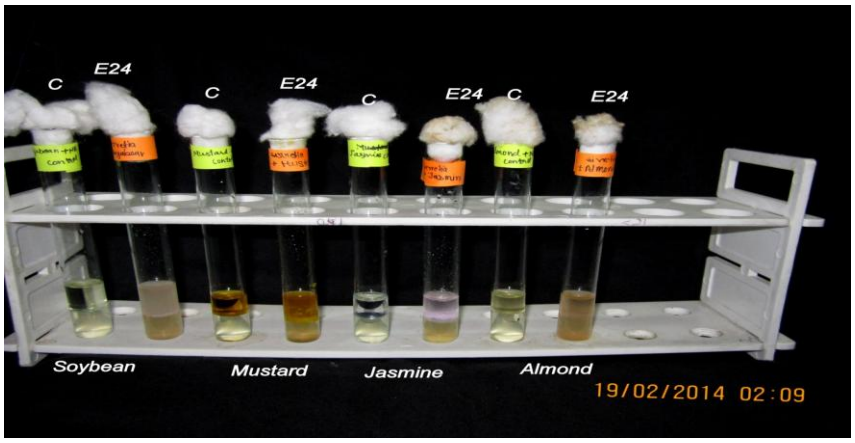


Plate: 2 Emulsification activity of cells of *Serratia marscecens* in BH broth

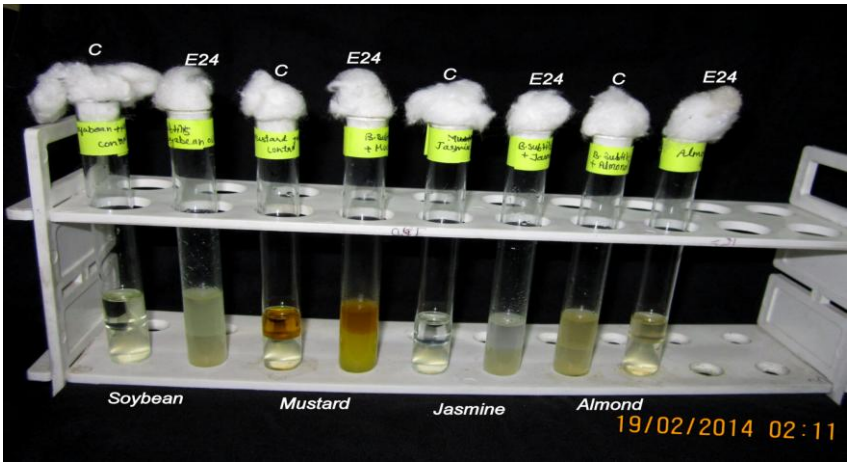


Plate: 3 Emulsification activity of cells of *Bacillus subtilis* in BH broth

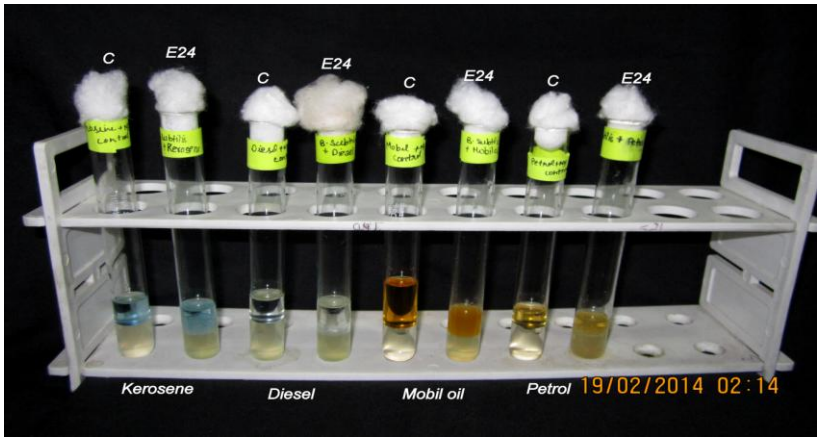


Plate: 4 Emulsification activity of cells of *Bacillus subtilis* in BH broth

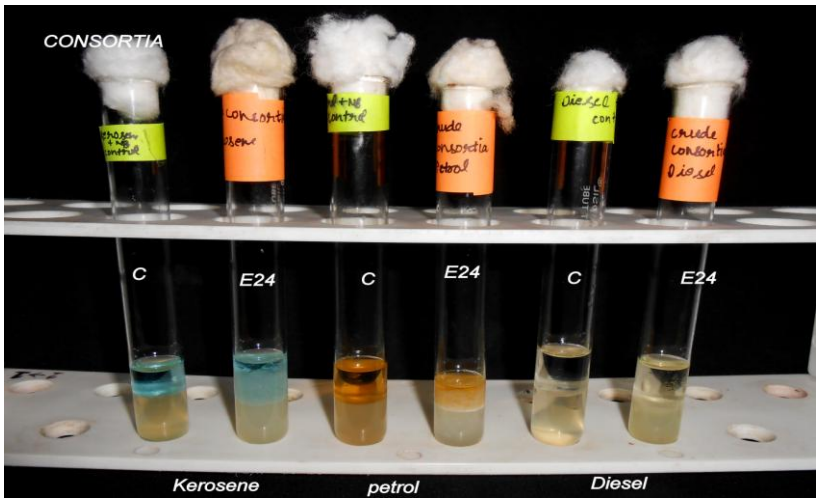


Plate: 5 Emulsification activity of cells of consortia in BH broth

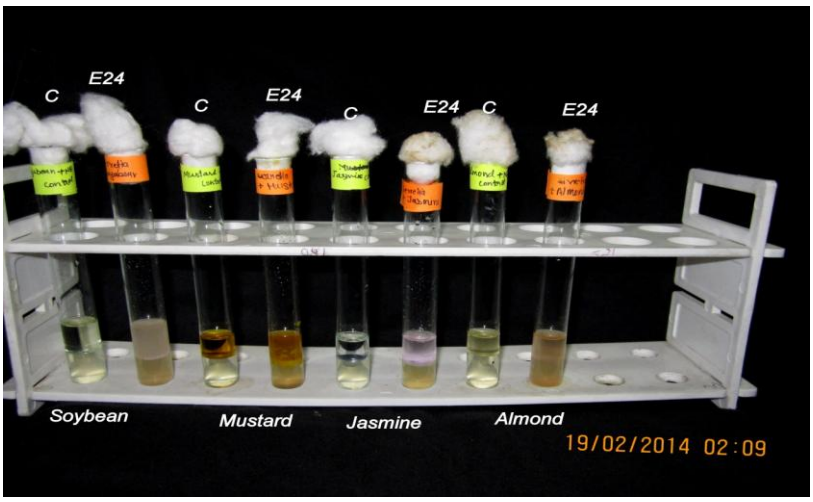


Plate: 6 Emulsification activity of cells of consortia in BH broth

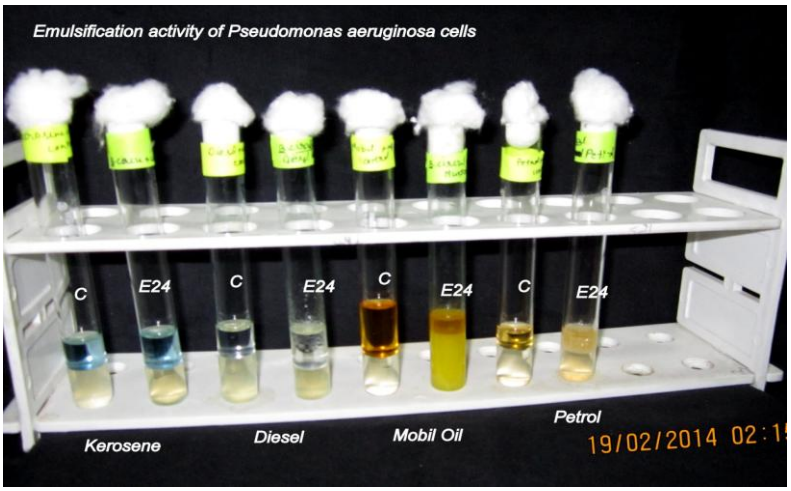


Plate: 7 Emulsification activity of cells of *Pseudomonas aeruginosa* in BH broth

Discussion

Microorganisms synthesize an extensive array of biosurfactants, amphipathic molecules that typically concentrate at the interfaces between hydrophobic and hydrophilic phases or surfaces, be they solids, liquids or gasses. As with chemical surfactants, they function to reduce surface or interfacial tensions to form emulsions, and they have the ability to form molecular aggregates including micelles. They may also facilitate cell uptake of extracellular natural organic or indeed inorganic nutrients, or nutrients associated with other living cells through various types of cell-cell interaction including pathogenesis. These interfacial processes may result in formation of microbial cellular aggregates, including microbial biofilms and microbial pellets. These interfacial phenomena may occur naturally and

passively in the environment or may be promoted or engineered in bioprocesses, most notably in bioremediation and biological waste treatment processes. Biosurfactants may also impact on the physiology of microbes by exhibiting toxic or inhibitory effects, either directly or indirectly, through pseudosolubilisation of chemicals which may be toxic to specific microbial species. In a different scenario, where microbes have hydrophobic surfaces which enable them to interact directly by surface contact with hydrophobic contaminants addition of biosurfactants or chemical surfactants can counteract this interaction with potential to reduce rates of uptake and transformation of the contaminants by the microbes. The amphipathic nature of microbial biosurfactants and/or the hydrophobic properties of microbial cell surfaces may be exploited to displace emulsifiers present at the oil-water interface of petroleum emulsions to break the emulsion. The microbial cultures applied to the emulsions utilize hydrocarbon components to support growth and biosurfactant production. Indeed such biodegradations of hydrocarbon components at the water/oil interface may also contribute to the de-emulsification process.

Literature survey illustrates that detailed studies of BS/BE production have been carried out in *Acinetobacter*, *Pseudomonas*, *Bacillus*, *Serratia*, *Candida* spp. BS producing microbes from different resources, *viz*., fresh water, soil, marine, oil wells and industrial effluents have been studied extensively. Among these natural resources, marine environment is attracting interest from many researchers due to its vastness and novelty with respect to products that can be obtained. However, this survey clearly illustrates that the maximum reports are focused on rhamnolipid and surfactin production from *Pseudomonas* and *Bacillus* spp. respectively. Few researchers have reviewed the enormous data generated on BS/BE production in microorganisms, briefing molecular biological aspects. The mystery why microbes produce BS/BE is still unknown. Justifications include survival on various hydrophobic substrates and desorption from the hydrophobic substrates allowing direct contact with cell, thereby increasing the bioavailability of insoluble substrates. However, few microbes produce BS/BE on water soluble substrates. Different biosynthetic pathways and specific enzymes are involved. Synthesis takes place by de novo pathway and/or assembly from substrates. BS/BE producing microbes may harbour plasmids. However, genes responsible for BS production are located on chromosomal DNA. Interacellular communication and production of enzymes, pigments and BS occurs by QSS which depends on the production of diffusible signal molecules termed autoinducers. The regulatory machinery is different for different BS/BE producers. *Serratia*, a Gram-negative organism is known to produce extracellular surface active and surface translocating agents. *S. marcescens* produces a cyclic lipopeptide BS 'Serrawettin' which contains 3-hydroxy-C10 FA side chain. BS production is correlated with populational surface migration. Techaoei *et al.* (2007) did preliminary screening of biosurfactant producing microorganisms isolated from hot spring and garages in northern Thailand and reported the emulsification at 24, 36 and 48 h of incubation. In this concept, the biosurfactant molecules act as mediators, which increase the mass transfer rate by making hydrophobic pollutants more bioavailable for microorganisms (Inakollu *et al.* 2004; Whang *et al.* 2009). Alternatively, biosurfactants may also induce changes in the properties of cellular membranes, resulting in increased microbial adherence. Hydrocarbons are organic compounds made of carbon atoms bound to each other forming a backbone with hydrogen atoms attached to the remaining sites on carbon. The carbon backbone can be straight or normal, branched, or cyclic (Olah and Molnar, 1995). The specific degradation mechanisms are determined by the compound structure. Linear alkanes degrade through b-oxidation in which the backbone is broken up two carbons at a time and the resulting acetyl-CoA is mineralized in the TCA cycle. Some cyclic alkanes degrade through cometabolism (Juhasz *et al.* 1996). Aromatic compounds are generally degraded via a dioxygenase enzyme, which converts the compound to a catechol followed by ring fission in the ortho or meta positions (Prince, 1993). Emulsification is a process that forms a liquid, known as an emulsion, containing very small droplets of fat or oil suspended in a fluid, usually water. The high molecular weight biosurfactants are efficient emulsifying agents.

Conclusion

In conclusion, the research revealed the emulsifying potential of broth cuture of *Pseudomonas aeruginosa*, *Serratia marscecens* and *Bacillus subtilis* along with the consortium of the three mentioned bacteria potent to show biosurfactant activity and emulsification at oil water interphase. The consortium was even potent of producing stable emulsion in the aforementioned hydrocarbons and vegetable oils. Comparatively vegetable oils were emulsified effectively than hydrocarbons.

Therefore it could be recommended from the study that the crude consortium or individual crode biosurfactants could be used as strong emulsifying agents.

Acknowledgements

The authors offer gratuitous thanks to Hon'ble Vice Chancellor, Most Rev. Prof. R.B. Lal, SHIATS, Naini, Uttar Pradesh, India for provision of research conductance. Heartfelt thanks to Head, Department of Microbiology and

Fermentation Technology, JSBB, SHIATS, Allahabad, Uttar Pradesh, India for the kind cooperation towards the research.

References

1. Amani H, Sarrafzadeh MH, Haghighi M, Mehrnia MR: Comparative study of biosurfactant producing bacteria in MEOR applications. *J Pet Sci Eng* 2010, 75:209-214.
2. Amedea P, Ivo R, Banat IM: Possibilities and challenges for biosurfactants use in petroleum industry. *Adv Exp Med Biol* 2010, 672:135-145.
3. Banat IM, Franzetti A, Gandolfi I, Bestetti G, Martinotti MG, Fracchia L, Smyth TJ, Marchant R, Microbial biosurfactants production, applications and future potential. *Applied Microbiology Biotechnology* 2010; **87**(2):427-444.
4. Banat IM: Biosurfactants production and possible uses in microbial enhanced oil recovery and oil pollution remediation: a review. *Biores Technol* 1995, 51:1-12.
5. Bodour AA, Maier RM. Biosurfactant: types, screening methods and applications. In: Bitton G, ed. Encyclopedia of Environmental Microbiology. New York: John Wiley & Sons, 2002:750-770.
6. Bonilla M, Olivaro C, Corona M et al. Production and characterization of a new bioemulsifier from *Pseudomonas putida* ML2. *J Appl Microbiol* 2005; 98:456-463.
7. Boþgelmez-Tinaz G. Quorum sensing in Gram-negative bacteria. *Turk J Biol* 2003; 7:85-93.
8. Cameotra SS, Makkar RS. Recent applications of biosurfactants as biological and immunological molecules. *Current Opinion Microbiology* 2004; **7** (3): 1–5.
9. Darvishi P, Ayatollahi S, Mowla D, Niazi A: Biosurfactant production under extreme environmental conditions by an fficient consortium, ERCPPI-2. *Colloids and Surfaces B: Biointerfaces* 2011.
10. Das M. Characterization of de-emulsification capabilities of a *Micrococcus* sp. *Bioresource Technol.* 2001; 79:15-22.
11. Desai AJ, Patel RN. Advances in biosurfactant production: A step forward to commercial applications. *J Sci Ind Res.* 1994; 53:619-629.
12. Desai JD, Banat IM. Microbial production of surfactants and their commercial potential. *Microbiol Mol Biol Rev* 1997; 61(1):47-64.
13. Dubey K, Juwarkar A. Determination of genetic basis for biosurfactant production in distillery and curd whey wastes utilizing *Pseudomonas aeruginosa* strain B2. *Indian J Biotechnol* 2004; 3(1):74-81.
14. Fiechter A. Biosurfactant moving towards industrial applications. *Trends Biotechnol.* 1992; 10:208-217.
15. Gautam KK, Tyagi VK. Microbial surfactants: *A review. J Oleo Sci*. 2006; 55(4):155-166.
16. Gunther NW, Nun˜ez A, Fett W et al. Production of rhamnolipids by *Pseudomonas chlororaphis*, a nonpathogenic bacterium. *Appl Environ Microbiol* 2005; 71(5):2288-2293.
17. Hommel RK, Ratledge C. Biosynthetic mechanisms of low molecular weight surfactants and their precursor molecules. In: Kosaric N, eds. Biosurfactant: Production, Properties, Applications. New York: Marcel Dekker, Inc., 1993:3-63.
18. Horng YT, Deng SC, Daykin M et al. The LuxR family protein SpnR functions as a negative regulator of N-acylhomoserine lactone-dependent quorum sensing in *Serratia marcescens*. *Mol Microbiol* 2002; 45:1655-1671.
19. Inge NA, Bogaert V, Saerens K et al. Microbial production and application of sphorolipids. *Appl Microbiol Biotechnol* 2007; 76:23-34.
20. Jaeger KE, Dijkstra BW, Reetz MT: Bacterial biocatalysts: molecular biology, three-dimensional structures, and biotechnological applications of lipases. *Annual Rev Microbiol* 1999, 53:315-351.
21. Kitamoto D, Isoda H, Nakahara T. Functions and potential applications of glycolipid biosurfactant—from energy-saving materials to gene delivery carriers. *J Biosci Bioengg* 2002; 94:187-201.
22. Kokare CR, Kadam SS, Mahadik KR *et al.* Studies on bioemulsifier production from marine Streptomyces sp. S1. *Indian J Biotechnol.* 2007; 6(1):78-84.
23. Lang S, Wullbrandt D. Rhamnose lipids-biosynthesis, microbial production and application potential. *Appl Microbiol Biotechnol* 1999; 51:22-32.
24. Magdalena P-P, Grazyna AP, Zofia P-S, Cameotra SS: Environmental applications of biosurfactants: Recent advances. *Int J Mol Sci* 2011, 12:633-654.
25. Maier RM, Soberon-Chavez G. *Pseudomonas aeruginosa* rhamnolipids: biosynthesis and potential applications. *Appl Microbiol Biotechnol* 2000; 54:625-633.
26. Maier RM. Biosurfactant: evolution and diversity in bacteria. *Adv Appl Microbiol* 2003; 52:101-121.
27. Maneerat S, Takeshi B, Kazuo H et al. A novel crude oil emulsifier excreted in the culture supernatant of a marine bacterium, *Myroides* sp. strain SM1. *Appl Microbiol Biotechno* 2006; 70(2):254-259.
28. Margesin R, Schinner F. Bioremediation (natural attenuation and biostimulation) of diesel-oil contaminated soil in an alpine glacier skiing area. *Appl Environ Microbiol* 2001; 67:3127-3133.
29. Mulligan CN: Environmental applications for biosurfactants*. Environ Pollution* 2005, 133:183-198.
30. Nitschke M, Siddahartha GVAO, Contiero J**.** Rhamnolipid Surfactants: An Update on the General Aspects of these Remarkable Biomolecules. *Biotechnology Progress.* 2005; **21** (6): 1593-1600.
31. Okpokwasili GC, Ibiene AA: Enhancement of recovery of residual oil using a biosurfactant slug. *African J Biotech 2006, 5:453-456.*
32. Olivera NL, Commendatore MG, Delgado O et al. Microbial characterization and hydrocarbon biodegradation potential of natural bilge waste microflora. *J Ind Microbiol Biotechnol* 2003; 30:542-548.
33. Palashpriya Das, Soumen Mukherjee, Ramkrishna Sen. 2009. Substrate dependent production of extracellular biosurfactant by a marine bacterium. *Bioresource Technology*. 100 (2009) 1015–1019.
34. Pedroza-Rodríguez, Aura M. Leonardo Sastoque-Cala, Alba M. Cotes-Prado, Refugio Rodríguez Vázquez. 2010. Effect of nutrients and fermentation conditions on the production of biosurfactants using rhizobacteria isolated from fique plants. *Universitas Scientiarum. 15 N° 3: 251-264.*
35. Peypoux F, Bonmatin JM, Wallach J. Recent trends in the biochemistry of surfactin. *Appl Microbiol Biotechnol* 1999; 51:553-563.
36. Philp JC: Effect of biosurfactants on crude oil desorption and mobilization in a soil system*. Environ Int.* 2005, 31:155-161.
37. *Priya, T. and Usharani, G.* 2009. Comparative Study for Biosurfactant Production by Using *Bacillus subtilis* and *Pseudomonas aeruginosa. Botany Research International* 2 (4): 284-287.
38. Ron E, Rosenberg EZ. Natural role of biosurfactants. *J Environ Microbiol* 2001; 3(4):229-236.

39. Salehizadeh H, Mohammadizad S: Microbial enhanced oil recovery using biosurfactant produced by *Alcaligenes faecalis*. *Iranian J Biotechnol* 2009, 7:216-223.
40. Satpute SK, Bhawsar BD, Dhakephalkar PK et al. Assessment of different screening methods for selecting biosurfactant producing marine bacteria. *Indian J Marine Sciences.* 2008; 37(3):243-250.
41. Satpute SK, Dhakephalkar PK, Chopade BA. Biosurfactants and bioemulsifiers in hydrocarbon biodegradation and spilled oil bioremediation. Indo-Italian brain storming workshop on technology transfer for industrial applications of novel methods and materials for environmental problem. 2005; 1-18.
42. Schmidt-Dannert C: Recombinant microbial lipases for biotechnological applications. *Bioorg Med Chem* 1999, 7:2123-2130.
43. Sekhon, K K., Khanna S. and Singh, S. Cameotra. 2011. Enhanced biosurfactant production through cloning of three genes and role of esterase in biosurfactant release. *Microbial Cell Factories*. 10:49 http://www.microbialcellfactories.com/content/10/1/49
44. Shavandi M, Mohebali G, Haddadi A, Shakarami H, Nuhi A: Emulsification potential of a newly isolated biosurfactant producing bacterium, *Rhodococcus* sp. strain TA6. *Colloids and Surfaces B: Biointerfaces* 2011, 82:477-482.
45. Shete AM. Studies on isolation, biochemical and physiological characteristics, antibiotic and bioemulsifier production and plasmid genetics of marine *Acinetobacter* 2003. A Ph.D. Thesis submitted to the University of Pune, Pune, India.
46. Soberon-Chavez G, Aguirre-Ramirez M, Ordonez L. Is *Pseudomonas aeruginosa* only “Sensing Quorum”? *Crit* Rev Microbiol. 2005; 31(3):171-182.
47. Syldatk C, Wagner F. Production of biosurfactants. In: Kosaric N, Cairns WL, Gray, NCC, eds. BioSurfactants and Biotechnology. New York: Marcel Dekker, Inc., 1987:89-120.
48. Turkovskaya OV, Dmitrieva TV, Muratova AY. A biosurfactant-Producing *Pseudomonas aeruginosa* Strain. *Appl Biochem Microbiol* 2001; 37(1):71-75.
49. Wei Y, Lai HC, Chen SU et al. Biosurfactant production by *Serratia marcescens* SS-1 and its isogenic strain SMΔR defective in SpnR, a quorum-sensing LuxR family protein. *Biotechnol Lett* 2004; 26:799-802.
50. Wei YH, Chu IM. $Mn2^{+}$ improves surfactin production by *Bacillus subtilis Biotechnol Lett* 2002; 24:479-482.
51. Youssef N, Simpson DR, Duncan KE, McInerney MJ, Folsbee M, Fincher T, Knapp RM: *In situ* biosurfactant production by *Bacillus* strains injected into a limestone petroleum reservoir. *Appl Environ Microbiol* 2007, 73:1239-1247.

THE END

ARTICLE

5

CROP CONCENTRTION AND THEIR CHANGES IN DROUGHT-PRONE AREAS IN JALGAON DISTRICT, MAHARASHTRA, USING GEOGRAPHICAL INFORMATION SYSTEM

Mr. Namdeo Patil*, Dr. D. S. Suryawanshi[1] & Dr. A. L. Suryawanshi[2]
[*2]Associate Professor, Dept. of Geography, NYNC, Arts, Sci. and Com. College, Chalisgaon, Jalgaon, INDIA
[1]Assistant Professor, Dept. of Geography, Vidyawardhini College, Dhule, INDIA

Abstract:

The paper presents an overview of agricultural cropping concentration and crop wise changes at micro level in drought-prone areas in Jalgaon district. Crop concentration means the variation in the density of any crop in a region at a given point of space and time. The crops have a tendency to have high concentration in the areas of ideal agro-climatic conditions and the density declines as the geographical conditions become less conducive. It is because of these factors that cotton has high concentration in black soil region like Khandesh (Deccan Plateau). The study area is mainly suitable for climatic conditions, so the cropping concentration is high. But recently the concentration of cereals sectors like Jowar, Bajara, etc have been decreasing. There has been a significant variation in the area, patterns of the crop concentration in the study region. This study is based on secondary data collected from statistical and revenue record in the tahsils of Jalgaon district. Data of cropping concentration is taken for 20 years. Crop-wise changes are used for analysis. Based on data of crop wise changes, the data is analyzed using GIS for mapping.

Introduction

Agriculture in drought-prone areas in Jalgaon district is the main source of livelihood. Cultivation has been the major occupation of the local inhabitants of drought- prone areas in Jalgaon district. The land is ideally suited for growing crops like Jowar, Cotton, Oilseeds, etc. cropping patterns are the proportion of area under various crops at a point of as it changes over space and time. The cropping patterns of a region are closely influenced by the geo- climatic, socio-economic, historical and political factors Hussain, M.(1996). Knowledge of concentration pattern in a region may be considered very useful in proper agricultural landuse planning. Cropping patterns of region are manifestation of combined influence of physical and human environment. Differences in attitude towards the rural land in the level of prosperity and technology have produced changes in emphasis. Their effect on both landscape and landuse studies are likely to be far reaching Coppock, J. (1968). Weather plays a decisive role in determining the existing cropping pattern. In the simple words cropping pattern means the production of area under various crops at a point of time. It is a dynamic concept because no cropping pattern can be said to be ideal for all times to a particular region. It changes in space and time with a view to meet requirements and is governed largely by the physical as well as cultural and technological factors. The change in cropping pattern in particular span of time clearly indicates the changes that have taken places in the agricultural development. Different geographers have applied location quotient method to work out degree of the crop concentration in specific density of any crop in a given region at a point of time, Punithavathi, J. (2012). The pioneer geographers - Florence, (1948), Chisholm(1962), Bhatia (1965), Jasbir Singh (1976) are the contributors to mark the agricultural region with the help of the quotient method.

Study Area

The study area is located in the drought-prone areas of Jalgaon district in the North of the Maharashtra state. These drought-prone areas are identified by Subramaniam V. (1987) Review Committee appointed by the Maharashtra state government. These drought-prone areas include tahsils- Amalner, Dharangaon, Muktainagar, Parola, Erandol, Bhadgaon, Chalisgaon, Pachora and Jamner .There are 09 tahsils which are selected for the present study which cover an urban area of 51.50 sq. km and rural area 6943.04 sq. km. It lies between 20011’ to 21013’north latitudes and 74046’ to 76024’ east longitudes (Fig. No 1).The region has good drainage network by Girna, Waghur, Tittur, Bori, Anjani and Purna basins .These rivers are left bank tributaries of Tapi river in Jalgaon district (M.S.). But still this area is facing a problem of shortage of water for domestic and irrigation purposes. The total population of the region was about 21, 21,832. Out of it the rural population was 17, 19,515 and the urban population was 4, 02,317 as per Jalgaon District Census (2011).

Objectives

1) To study the tahsilwise crop concentration and its variation in the study area.
2) To search the agricultural crop wise changes in study area.
3) To use GIS for crop mapping.
4) To identify the areas of crop concentration on the basis of specific method.

Database and Methodology

For the clear cut picture of the study of patterns of land utilization, cropping patterns are made with the help of secondary data obtained from statistical, agricultural and soil survey offices of Jalgaon district. In order to determine the tahsilwise concentration of 09 selected crops like Jowar, Bajara, Pulses, Cotton, etc during the years 1998-2000 and 2008-2010. Bhatia's method is used for the calculation of the location quotient. The study area consists of 21 toposheets of 46K/16, 46O/4 to 46O/16, 46L/13 to 46L/15,46P/1 to 46P/14, 55C/4 to 55C/8 and 55D/1 to 55D/5 which are the scale of 1:50,000. Crop concentration was determined by the following formula. The data relating to the maps are prepared by using GIS techniques. In general, higher the Crop Concentration Index, higher is the level of interest in the production of that crop.

$$\text{Index for determining Concentration of crop 'a'} = \frac{\text{Area of crop 'a' In the component Area unit}}{\text{Area of all crops In the component Areal unit}} \div \frac{\text{Area of crop 'a' in the entire region}}{\text{Area of all crops in the entire region}}$$

Discussion

Crop concentration refers to the density or areal occupancy of a crop in a region. The occupancy (high, medium and low) is determined largely by the terrain and climate, transport facilities and demand of the crop. The study of crop concentration as a measure of the intensity of crops in a region is considered to be a step ahead in determining the regional character of distribution of crops to highlight the importance of one crop over another.

Crop Concentration Analysis

Recently the crop concentration analysis, studies have gained momentum and its important, it is increasing day by day .Crop concentration studies provide an adequate understanding of an individual crop geography. Crop concentration is in itself and integrative reality that demand distribution analysis. Crop concentration regions are essential for the construction of still more complex structure of different agricultural region.

The objectives of the study of crops concentration pattern are mainly to differentiate the areas of high and low density of the individual crops in the different parts of the tahsils. The details are given in the Table (1 & 2).

The crop concentration has been identified in tahsilwise for the year 1998-2000 to 2008-2010.under the zone by which high concentration (A), medium concentration (B) and low concentration (C).

Jowar

Jowar crop has been most suitable and important food crop in the study area. Jowar has the 2nd rank crop. The concentration of Jowar has been in 3 categories e.g. high, medium and low. High level of Jowar concentration was observed in Amalner, Dharangaon, Erandol and Muktainagar tahsils, while low level concentration was experienced in Chalisgaon and Jamner tahsils (Fig. No. 2) during the period of investigation. Whereas moderate to low level change was recorded in Pachora tahsil while High to low level change was observed in Bhadgaon tahsil and High to Moderate level change was found in Parola tahsil. High yielding varieties of Jowar seeds, farmers attitude, physical factors and poor climatic conditions due to climatic changes are responsible for the change in Jowar concentration during period under study.

Bajara

It is also suitable and important food crop in the study area. Bajara is the 4th rank crop. High level of Bajara concentration was noticed in Parola and Chalisgaon while Medium concentration was observed in Amalner and Pachora tahsils, whereas low concentration was found in Dharangaon, Muktainagar, Jamner, Erandol and Bhadgaon tahsils. No change in Bajara concentration was seen in all tahsils (Fig No 3) between the year 1998-2000 to 2008-2010.

Wheat

Wheat covers negligible area of the total cultivated area in the study region Table 2 & Fig No 4 show that Medium level of wheat concentration was observed in Parola and Erandol tahsils while low level concentration was observed in Chalisgaon tahsil, whereas high to low level of change was recorded in Amalner, Jamner and Muktainagar tahsils. Medium to high level of change was recorded in Dharangaon and Bhadgaon tahsils while Low to medium level of change was registerd in Pachora tahsil during period under study. Wheat is traditional diet of the people of the region so they prefer to grow wheat for their own consumption as well as for the market. Due to Rabi season, fluctuating and limited irrigation facilities are responsible for the change in wheat concentration.

Pulses

Pulses are 3rd ranking crop in the study area. Fig No 5 indicates that High level of pulses concentration were observed in Erandol tahsil while medium concentration observed in Dharangaon, Pachora and Jamner tahsil. Low level pulses concentration was recorded in Bhadgaon tahsil. High to medium level of change was found in Amalner tahsil while medium to low level change was observed in Parola tahsil, whereas low to high was recorded in Chalisgaon tahsil. Farmers' attitude, poor climatic condition due to climatic changes and low production are responsible for the change in pulses concentration.

Oilseeds

Oilseed crops cover very small area of the total cultivated area in the study region. But the concentration of Oilseed crops is in three zones. High level of oilseed concentration was found in Dharangaon tahsil (Fig No 6) while medium level concentration was recorded in Parola tahsil whereas low level of concentration was observed in Chalisgaon and Pachora tahsils. High to medium level of change was experienced in Amalner and Jamner tahsils while low to medium level change was recorded in Bhadgaon tahsil. Low to high level of change was observed in Muktainagar and Erandol tahsil. The same is the reason for the change in oilseed concentration.

Cotton

Cotton is the 1st ranking and major commercial crop in the study area. The study area is suitable for climatic conditions, regur soil, increasing irrigation facilities and new water conservation and management schemes implemented by the government, good price given to it in market and also due to new varieties of HYV seeds. It is clear that the concentration of cotton was higher level in the Jamner tahsil. Medium level of concentration was observed in Parola, Bhadgaon, Pachora and Dharangaon tahsils whereas Low concentration was observed in Chalisgaon, Amalner and Erandol tahsils. Medium to low level of change was noticed in Muktainagar tahsil (Fig No 7).

Sugercane

Sugercane concentration was high in Erandol and Chalisgaon tahsils while low concentration was found in Amalner, Parola, Muktainagar and Jamner tahsils. Medium to low level of sugarcane concentration was registered in Bhadgaon and Pachora tahsils while low to medium of change was recorded in Dharangaon tahsil (Fig No 8). Loss of sugar mills increasing water scarcity and erratic monsoon are responsible for the change in sugarcane concentration.

Fruits

High concentration of fruit crops was observed in Muktainagar and Bhadgaon tahsils while medium concentration was observed in Pachora tahsil and low concentration was recorded in Amalner, Parola, Erandol and Jamner tahsils whereas medium to low level of fruits change was observed in Dharangaon and Chalisgaon tahsils (Fig No 9). The main reason for this change is poor climatic conditions due to climate change in fruits concentration.

Other Crops

Other crop category includes vegetables like onion and corn, and cover sizable area of the total cultivated area in the study region. High concentration of other crops was recorded in Erandol tahsil. Medium level concentration was observed in Dharangaon , Muktainagar, Chalisgaon, Bhadgaon and Pachora tahsils while low to medium level of other crops concentration was recorded in Parola and Jamner tahsils (Fig No 10). The reason behind it is a good price given to it in market and also due to new varieties of HYV seeds.

Crop Wise Changes From 1998-2000 to 2008-2010

The researcher has identified the area wise changes of agriculture crops in cropping pattern and production too. The crops are taken for the account from 1998-2000 to 2008-2010 to analyze using simple statistical method and graphs from 1998-2000 to 2008-2010. The cotton crop has increased from 259 to 409 thousand hectares; Bajara crop has

increased from 52-53 thousand hectares. Other crops have increased from 17-23 thousand hectares in 1998-2000 to 2008-2010. These are the major crops of this region from same period. The agricultural and other major crops have gradually decreased in the study area. The crop wise changes are given in Table 4.

Conclusion

The spatial variation in the degree of crop concentration area is found to be the result of the different interactions such as physiographic, climatic, hydrological, socio-economic and technological factors in organizational effect of the study region. Fig. No. 12 reveals that Cotton, Bajara, Fruits and other crops have increased on the other hand Jowar, Pulses, Oilseeds and Sugercane crops have decreased in cultivation and production. The main reason for this decrease is poor climatic conditions due to climatic changes .Hence the government should take the appropriate steps to stable the Jowar, Pulses, Wheat and Oilseeds cultivation to save the steaming population. Besides, the Regional Level River Joining Project is to be executed to avoid water scarcity for drinking and agriculture.

References

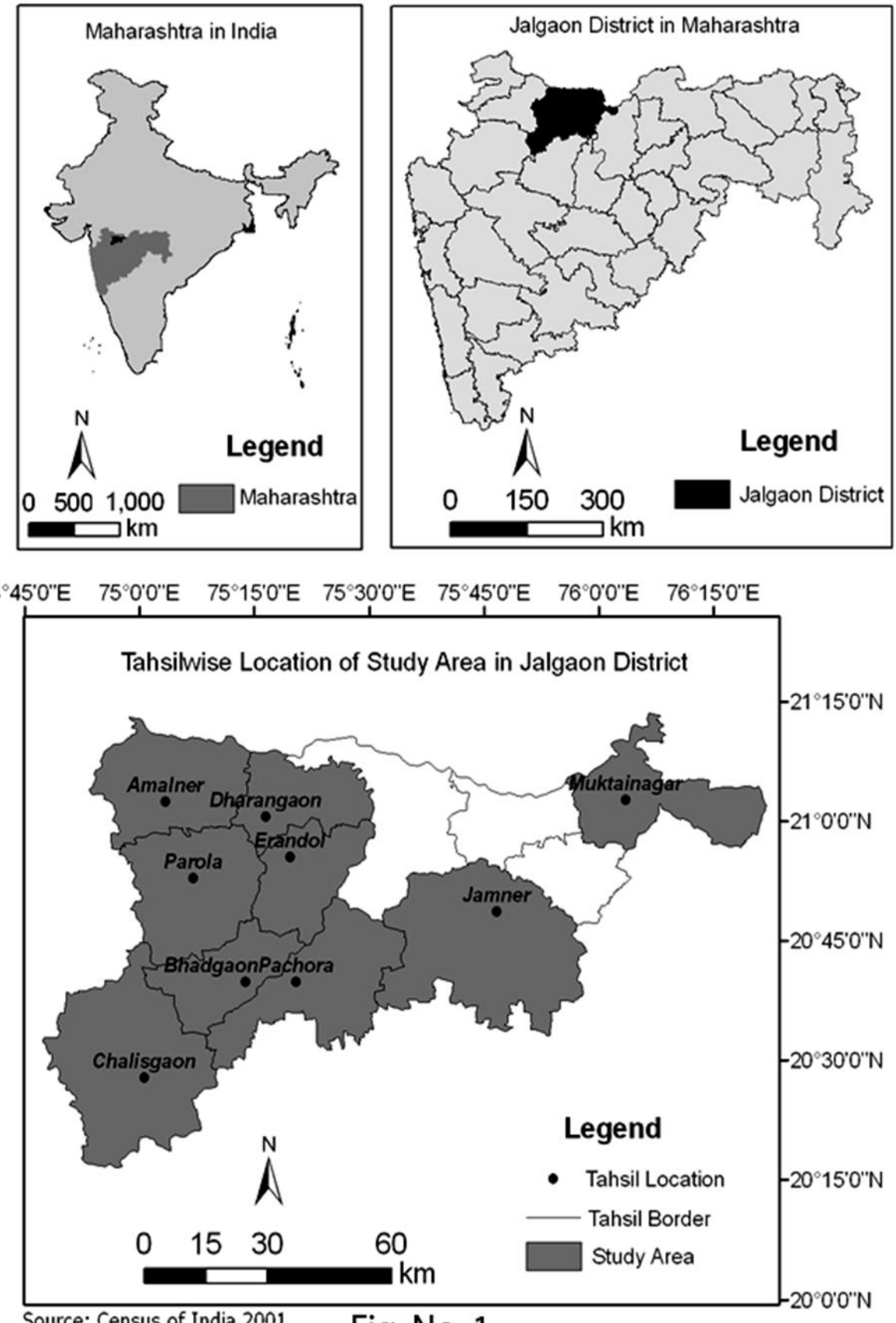
Journals

1) Bhatia S.S.(1965),"Pattern of crop concentration in India", Economic Geography ,vol.41 No.1 Jan 1965,pp 40,41,53,55.
2) Census of Maharashtra (2011): Maharashtra Census Handbook of Jalgaon District.
3) Coppock, J.T. (1968) Changes in land use in Great Britain, in Landuse, Institute of British Geographers special publication no.1 p.111.
4) Fischer, G., Frohberg, k., Parry, M.L., Rosenzweig, C., 1996. Impacts of potential climatic change on global and regional food production and vulnerability. In: Downing, T.E. (Ed.), NATO ASI Series, vol.137, Climate change and world Food Security Springer, Berlin.
5) Kashid D.L. and Kashid N.D.(2010), Crop concentration in SINDHUDURG DISTRICT: A Geographical Analysis Dec. 28,2010 Geo-science Research vol.1 issue 2,210 pp- 28-33
6) Najmul Islam Hasmi, (2012)"pattern of crop concentration and Diversification in Upper Gangs Yamuna Doab", Innovative research and Development ISSN: 2278-0211 online August, 2012, pp 481-494.
7) Punithavathi, J. (2012): "Agricultural concentration and crop wise changes in Tanjawar District Tamilnadu, using Geographical Information System". International Multidisciplinary Research Journal 2 to (7), pp 44-48
8) Rosenzweig, C., parry, M.L.1994.Potential impacts of climate change on world Food Supply. Nature 367, pp133-138.
9) Subramaniam V. (1987): A Report of the Committee for determination of drought prone area appointed by government of Maharashtra, headed by Subramaniam V. pp 43-44
10) World Food Institute. 1988. World Food Trade and U.S. Agriculture ,1960-1987,Iowa State University, Ames

Books

1) Hussain, M.(1996),Systematic Agricultural Geography, Represented 2004, Rawat Publication, Jaipur and new Dehli,pp.217-218

Study Area: Location Map



Source: Census of India 2001

Fig. No. 1

STUDY AREA: TAHSILWISE CROP CONCENTRATION

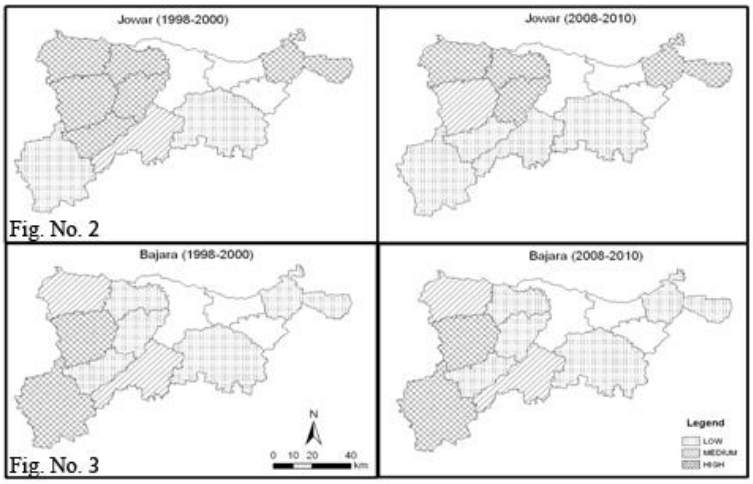


Fig. No. 2

Fig. No. 3

STUDY AREA: TAHSILWISE CROP CONCENTRATION

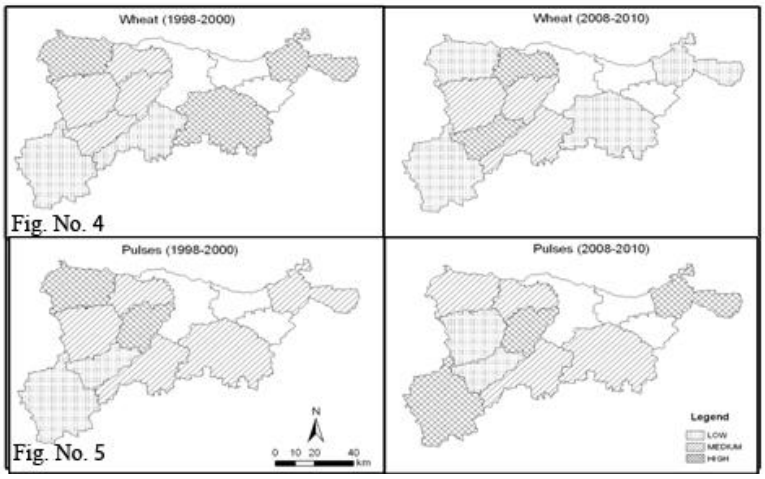


Fig. No. 4

Fig. No. 5

STUDY AREA: TAHSILWISE CROP CONCENTRATION

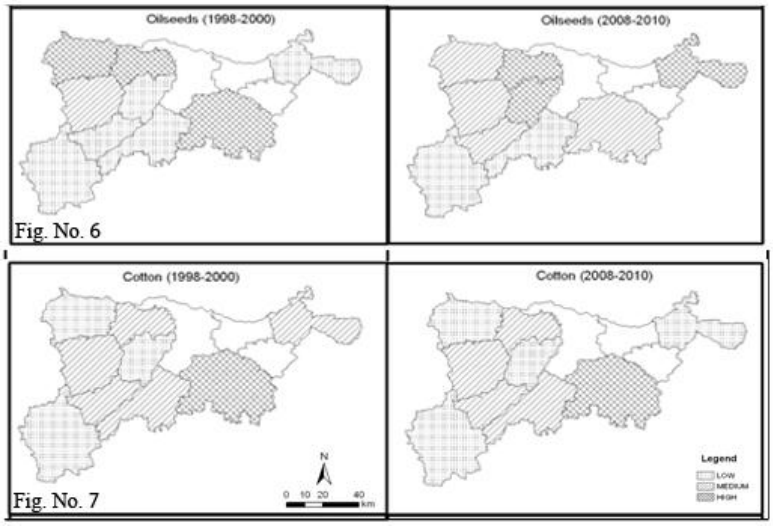


Fig. No. 6

Fig. No. 7

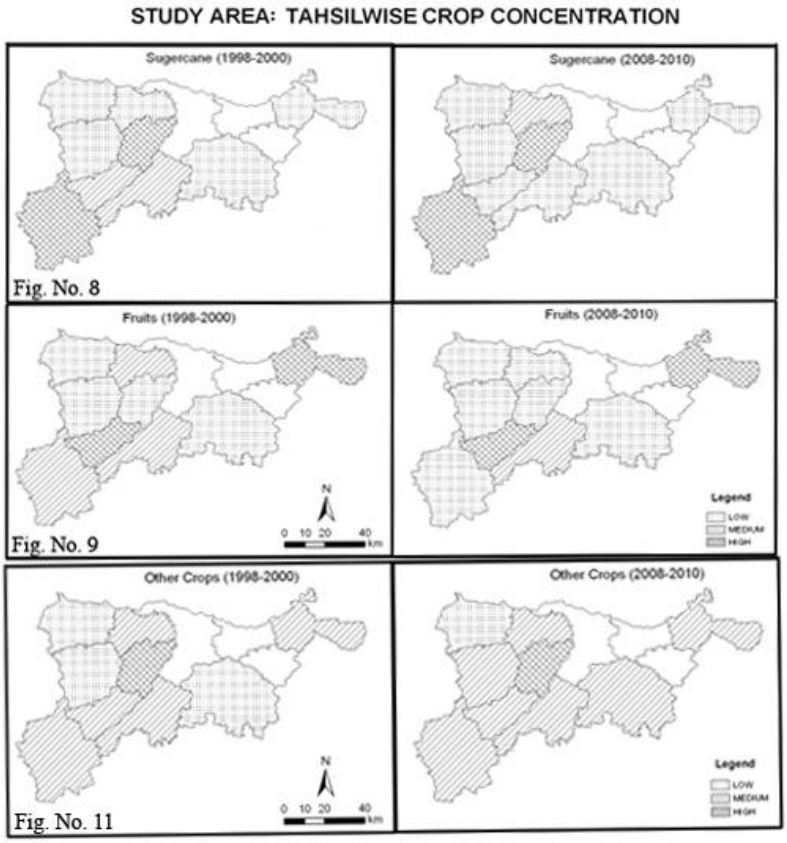


Fig. No 12: Agriculture Crop wise changes

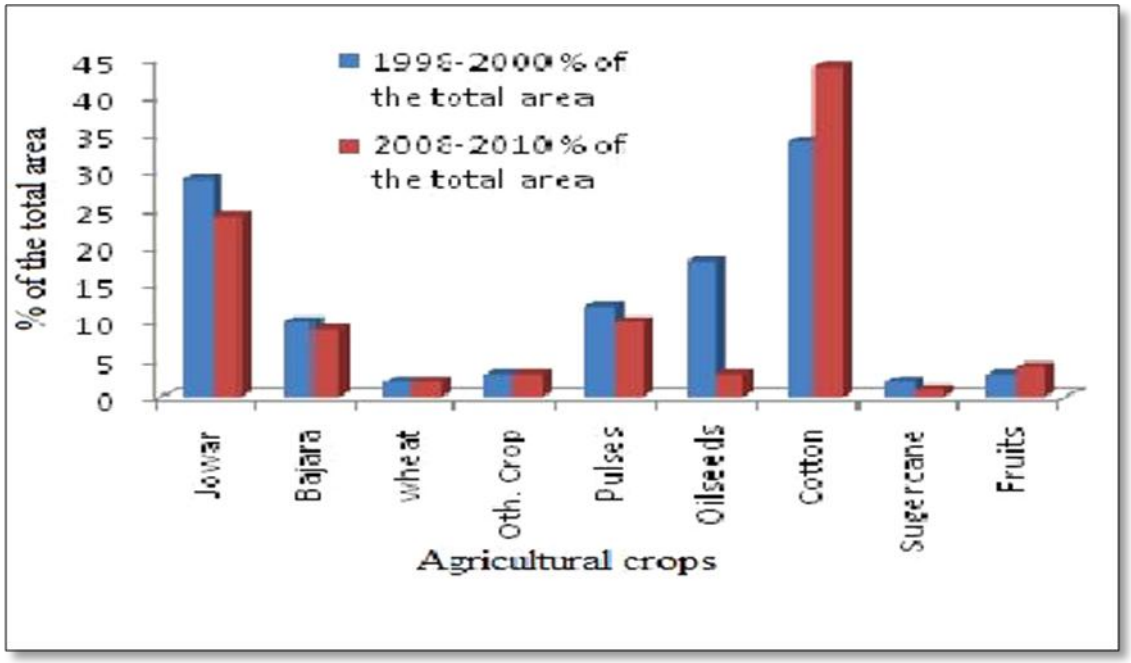


Table 1: Concentration in zone wise

Types of zone	Concentration	Levels of concentration
Zone A	High	High level concentration
Zone B	Medium	Medium level concentration
Zone C	Low	Low level concentration

Source: Computed by Researchers

Table 2: Study area: Tahsilwise Crop Concentration (1998-2000 to 2008-2010)

Sr. No.	Tahsil	Year	Jowar	Bajara	Wheat	Other Crops	Pulses	Oilseeds	Cotton	Sugar.	Fruits
1	Chalisgaon	1998-2000	0.86	2.1	0.5	1.00	0.75	0.8	0.88	2.00	1.33
		2008-2010	0.79	2.3	0.5	1.00	1.2	0.67	0.84	2.01	0.5
2	Bhadgaon	1998-2000	1.03	0.7	1.00	1.00	0.75	0.4	1.06	1.00	3.00
		2008-2010	0.88	0.33	1.5	2.33	0.5	1.00	1.00	0.5	3.25
3	Pachora	1998-2000	0.97	0.9	0.5	1.00	0.83	0.8	1.12	1.00	1.67
		2008-2010	0.88	1.11	1.00	1.00	0.9	0.67	1.00	0.5	2.00
4	Parola	1998-2000	1.03	1.8	1.00	0.67	0.83	1.00	0.94	0.5	0.33
		2008-2010	1.00	1.56	1.00	1.00	0.6	1.00	1.07	0.5	0.25
5	Erandol	1998-2000	1.1	0.6	1.5	1.67	1.42	1.8	0.71	0.01	0.67
		2008-2010	1.21	0.44	1.00	1.67	1.5	1.67	0.8	2.03	0.75
6	Dharangaon	1998-2000	1.17	0.1	1.00	1.00	1.08	1.4	1.03	0.5	1.33
		2008-2010	1.25	0.11	1.5	1.33	0.9	1.33	1.00	1.00	0.75
7	Amalner	1998-2000	1.07	1.3	4.5	0.67	1.42	1.8	0.74	0.5	0.33
		2008-2010	1.33	1.44	0.5	0.67	0.9	1.00	0.84	0.5	0.5
8	Jamner	1998-2000	0.93	0.5	2.5	0.33	1.00	1.4	1.38	0.00	0.33
		2008-2010	0.75	0.33	0.5	1.00	0.9	1.00	1.43	0.00	0.25
9	Edlabad	1998-2000	1.25	0.00	2.5	1.00	0.92	0.4	0.94	0.5	2.67
		2008-2010	1.33	0.00	0.5	1.00	1.2	2.00	0.82	0.1	2.75

Source: Tahsil offices in Jalgaon district, 1998-2000 to 2008-2010, computed by the researchers.

Table No 3: Study area: level of concentration tahsilwise (2008-2010)

Crop Name	Index value	Level of concentration	Tahsil under zone
Jowar	> 1	A HIGH	Erandol, Dharangaon, Amalner, Edlabad
	.95-1	B MEDIUM	Parola
	< .95	C LOW	chalisgaon, Bhadgaon,Pachora,Jamner
Bajara	> 1.5	A HIGH	chalisgaon, Parola
	.75-1.5	B MEDIUM	Pachora, Amalner
	< .75	C LOW	Edlabad,Jamner,Dharangaon,Erandol,Bhadgaon
Wheat	> 2	A HIGH	Bhadgaon, Dharangaon
	1.0-2.0	B MEDIUM	Pachora,Parola,Erandol
	< 1.0	C LOW	Chalisgaon,Amalner,Jamner,Edlabad
Other crop	> 1.4	A HIGH	Erandol
	.7-1.4	B MEDIUM	Chalisgaon, Pachora, Parola, Dhargaon, Jamner, Edlabad
	< .70	C LOW	Amalner
Pulses	> 1.20	A HIGH	Edlabad, Chalisgaon, Erandol
	.80-1.0	B MEDIUM	Pachora,Dharangaon,Amalner,Jamner
	< .80	C LOW	Bhadgaon, Parola
Oilseeds	> 1.10	A HIGH	Edlabad,Dharangaon,Erandol
	.90-1.10	B MEDIUM	Bhadgaon,Parola,Amalner,Jamner
	< .90	C LOW	Chalisgaon, Pachora
Cotton	> 1.20	A HIGH	Jamner
	.90-1.20	B MEDIUM	Bhadgaon,Pachora,Parola, Dharangaon
	< .90	C LOW	Chalisgaon,Erandol,Amalner,Edlabad
Sugercane	> 2.0	A HIGH	Erandol, Chalisgaon
	1.0-2.0	B MEDIUM	Dharangaon
	< 1.0	C LOW	Bhadgaon,Pachora,Parola, Amalner,Jamner,Edlabad
Fruits	> 2	A HIGH	Bhadgaon, Edlabad
	1.0-2.0	B MEDIUM	Pachora
	< 1.0	C LOW	Chalisgaon,Parola, Erandol, Dharangaon, Amalner, Jamner

Source: computed by the researchers.

Table 4: Study area : Agricultural cropwise changes(1998-2000 to 2008-2010)

	1998-2000				2008-2010				
Sr. No.	Crops	Area "000" Hec.	Production "000"tonnes	% of the total area	Sr. No.	Crops	Area "000" Hec.	Production "000"tonnes	% of the total area
1	Jowar	149	215	29	1	Jowar	139	216	24
2	Bajara	52	67	10	2	Bajara	53	72	9
3	wheat	9	9	2	3	Wheat	9	10	2
4	Oth. Crop	14	17	3	4	Oth. Crop	20	25	3
5	Pulses	61	36	12	5	Pulses	56	45	10
6	Oilseeds	28	33	18	6	Oilseeds	18	22	3
7	Cotton	176	256	34	7	Cotton	259	409	44
8	Sugercane	8	374	2	8	Sugercane	8	819	1
9	Fruits	17	873	3	9	Fruits	23	1804	4

Source: Tahsil offices in Jalgaon district, (1998-2000 to2008-2010), and village survey.

THE END

ARTICLE

6

STUDY OF STRESS AT WORK PLACE AMONG MANAGEMENT FACULTY

[*]Richa Bajpai & [1]Dr. Shweta Srivastava
[*]Research Scholar, Monad University, INDIA
[1]Professor (IBS), IISE, Lucknow, INDIA

Abstract:

Stress is a universal element and persons from nearly every walk of life have to face stress. Frustration, conflict, tension and anxiety have become regular features of life. Arising both at work and at home, these conditions have a detrimental effect on the behavior of people and performance of any organization. The education is no exception to this, as it is an expanding service sector and faculty are like to experience greater job related stress caused by research, updates, curriculum and students interaction. The present study has made an attempt to analyze the workplace stress among the faculty in management institutions. The studies reveals that teachers are also prove to high stress resulting into negative effects both in terms of clinical as well as psychological trauma. The need of hour is to implement stress relieving techniques like delegation, role clarity, delegation, efficient time management etc to ensure quality delivery by teachers. This paper focus on sources and techniques to cope with stress.

Introduction

Stress refers to body's general response to environmental situations (Selye 1979). Marshall and Cooper (1981) argue that stress is a different phenomenon from 'pressure', "stress" is something more than mere pressure. It carries strong overtones of the breakdown of normal human performance. Stress is the 'wear and tear' of bodies, experience as we adjust to our continually changing environment, it has physical and emotional effects and can create positive and negative feelings. Across the world the corporate as well as society at large have been facing the trauma of stress in one form or the other.

Though academics is considered a low-stress job but pressure to develop future managers is somewhat stressful because raw input have to be made employable in order to suit the requirements of industry.

Background of the study

India is waking up to the fact that a lot of human potential is being drained away because of stress and burnout (chowdhary and Menon 1997). High level of stress results in high level of individual dissatisfaction , illness, absenteeism and turnover , low levels of productivity and as a consequence difficulty in providing high quality service to customer (organ and Bateman 1989; Matteson & Ivan Cevich 1987). The stress is also a by product of body chemistry when responding to external stimuli. A clinical approach to stress reveals the same mechanism of stress. According to ILO each year clinical depression alone causes a loss of some 200 people in the United States. In western countries bio- measurement of stress in quite common among corporate in order to design stress elimination mechanism. There are a no. of biological, psychological and behavioural stress (Cordes, Robbins and Parasuram). The cost of maintaining continuously high level of chronic stress is often a serious health break-down (Archer 1991). Turner (2002) indicated that stress chemicals that stay in the body can obstruct the digestive and immune system and also deplete human energy.

Studies on stress in India

Pareek (1983), Dube(1983),singh , Kaur and kaur(1983**)**- These studies are different from those of developed by Holmes and Rahe (1967).

Dastur (1986) -400 senior executives between age of 38-58% executives experience emotional stress and anxiety, 40% suffered overweight and health.

Capgemini, a global outsourcing firm which has offices in Mumbai, Kolkata Chennai, Bangalore reviews and addresses concerns raised by employees on issues that include relationships , favourtism and even health and safety. Jasmine (1987) – Comparing job stress of public and private sector blue collar employees –PSUs employees experienced more stress than private. Indian Council for Research on International Economic Relations (ICRIER) concluded that the losses from the occupational stress diseases could cost Indian Industry approximately 7800 trillions in the next 10 years if not checked. Survey in 81 companies was under taken as part of the research.

Sharma(1987)- Managers & supervisor of PSUs and private sector:

a) Private sectors scored higher on role conflict, role erosion, resource inadequacy and role isolation.
b) Supervisors in PSUs scored higher on role ambiguity.

Studies of stress among Academic Institutions

Although most of the studies have been carried out in corporate world. A both clinical as well as behavioral method have been developed to cope with stress among white collar as well as as blue collar employees across industries but little work has been done to address this issue among academicians. Several studies done abroad reveals that involvement of the teachers at the thinking, planning & decision making levels for bringing about autonomy was rather low. At the level of implementation their participation has been very high. About 50% of the teachers in autonomous colleges are involved in some kind of professional improvement programs such as writing research papers and books, participation in conducting of refresher courses. (Varghere 1993)

Incoming members of academic positions are now untenured, workloads have increased and academics are under increasing pressure to 'publish or perish'. (Winefield 2003)

Teaching profession was once viewed as a 'low stress occupation' (Fisher 1992) and they have been envied for tenure, light workloads, flexibility & other perks such as foreign trips for study & conferences. (winefield 2003)

However recent studies have demonstrated that university professors experience levels of stress that are unparalleled in any other employed group of individuals. University professors tend to experience higher than normal levels of stress and these high levels of stress have increased over the last 6 years. The overall stress level of professors is now second only to the recently.

Management faculty plays a vital role in the creation and dissemination of knowledge and innovation, addition to education and training. Above cited research demonstrated that high levels of occupational stress, if left unchecked and unmanaged, it will undermine the quality, productivity and creativity of employees 'work, and employees' well being (Gillispie et al.,2001). The studies on stress mainly confined to industry and limited work on stress has been done to address the issue of stress in academic institutions but management institutes specifically have not been covered. The rising career aspirations among MBA's and the expectations of industry have transformed the teaching methodology and made academicians from mere teachers to overall trainers and motivators.

Since the analysis of this paper is based on secondary data and focus group interviews and further studies are required for the purpose of concluding the following objectives and hypothesis.

A conceptual framework suggests the following:

- Identify major stressors among management faculty.
- To determine the major stress releving techniques among faculty.
- High stress is directly proportional to quality of delivery.
- High stress leads to mental disorders.

Sources of stress

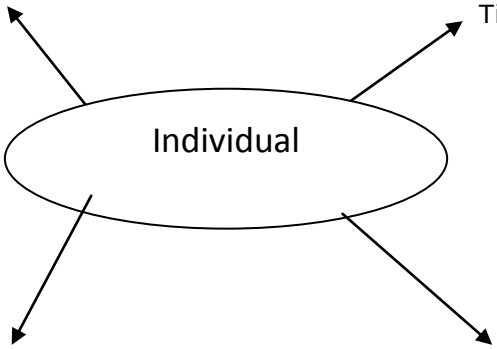
1) Role related stress like conflict , transfers, Job rotations.
2) Nature of the job (Inherent characteristics)
3) Interpersonal and group dynamics
4) Interface between organization and external environment.
5) Structural factors- Reporting relationship-(Etzioni 1984)
6) Non-work spheres- Home, social, ethical- Work and non work interface produces individual stresses.

Intrapersonal Stressors

- Role conflict
- Role overload
- Ethical Dilemna

Job Related Stressors

Nature of Job
Inbuilt stress
Transfer, Travel
Time pressure



Interpersonal Stressors

- Relationship with peers, subordinates, Boss.
- Interpersonal communication
- Interpersonal conflicts
- Group processes

Intra-organizational stressors

Noise, heat, lighting
Limited Resources
No Career paths

Stress and its implications

Xansa, as UK based outsourcing and Technology Company, encourages its employees to indulge in online games on the company intranet with the objective of improving their skills and concentration.

NIIT offers service benefits including marriage gifts, birthday bonus, transport subsidy, long service bonus, health club membership, credit card to those employees who stay with the company for more than 5 years.

Infosys technologies offer the stock option plan to all employees who remain committed and loyal.

A recent survey of 15000 middle and senior level executives has revealed that while the international cardiac risk status is 48%. The Indian executives cardiac risk status is approximately 56%. It is no wonder that India is rushing towards alternate methods of stress reduction at the workplace.

Kumar (1989)-PSU's executives shows that:

a) Unmarried scores high stress than married
b) Executives with PG are more able to do job than UG.
c) Marketing executives experienced more stress than HR/ Finance /Production.

Stress Level	**Low Stress**	**Optimum Stress**	**High Stress**
Behaviors	Low Motivation Careless mistakes Psychological Withdrawls Inactivity	High Motivation Hightened Perception High Involvement	Anxiety & Nervousness Indecisiveness Bad Judgement
Performance	Low performance	High Performance	Poor performance
Health Effects	Dull	Good	Insomnia, Psychosomatic illness

Techniques to cope with Stress

Behavioral scientist across the world have conducted experiments and clinical methods developed to cope with the stress.

(i) Enhancement of self-esteem
(ii) Planning and organizing at work.
(iii) Delegation
(iv) Prioritizing
(v) Efficient time management
(vi) Role clarity and refine
(vii) Mobilization of resources
(viii) Enhancing personal skills
(ix) Communicating with right people for problem solving
(x) Role analysis technique (RAT)

Clinical Techniques

- Bio feedback Mechanism
- Counseling

Conclusion

Stress may summarize in a physiological and psychological metabolism present in the very texture of human body. The studies also establish the fact that stress either required or acquired. Low level stress may put a positive pressure or instigate a person to induce an action. The behavioral theories of Herzberg suggest the urge of satisfies and motivators and McGregor's X theory also indicates the requirement of stress to make a person of Y. The sources of stress are also subject matter of external environment where a stimulus of any nature like Role Ambiguity lead to stress.

References

1. Parikh Margie, Gupta Rajen - Organisational Behaviour – Tata McGraw Hill Education Private Limited, New Delhi.
2. Sarma V.S.Veluri - Organisational Behaviour (Text and Cases) – Jaico Publishing House, Bangalore
3. Michael V.P – Research Methodology In Management–Himalaya Publishing House, New Delhi.
4. Kang Singh Lakhwinder And Sandhu Singh Rashpal, "Impact of stress on health : A study on bank branch managers in India" g, Volume 1, No – 2, June 2012, Pg.285 -296, Published by IMI SAGE.
5. Beehr TA, Newman JE (1978). Job Stress, employ Health and Organizational Effectiveness - A fact analysis model and literature reviews. Personal Psychology, Vol. 31, Pg.665-669.
6. Sathyanarayana K. S. and Maran K,"Job Stress Of Employees" International Journal Of Management (IJM), Volume 2, Issue 2, 2011, Pg. 93-102, Published by IAEME.

THE END

ARTICLE

7

WATER: A MILLION DOLLAR CRISIS OF 21ST CENTURY IN INDIA

Lakhya Pratim Nirmolia
Assistant Professor, Department of History, Kakojan College, Jorhat, Assam, INDIA

Abstract:

The aim of the study was to formulate and evaluate Water is the life of all living things in the world. Water is necessary from insects to human beings. In our solar system except our earth water is not available in the other plants. In ancient times nobody could understand about the value and necessarily of water as like today. Because during that time there was not any big industry, human population was also not increase like today. Today all human beings especially in 3rd and 4th world countries are fall in victims of water crisis. People of these countries are not able to use safe drinking water as they wise. Development of science and technology and also rapid industrialization create a lot of problem in water and its use.

Introduction

Water is probably the only natural resources to touch all aspects of human civilization from agricultural and industrial development to the cultural and religious values embedded in society"—said by Koitsur Matchur, chairman of UNESCO (*Water & Culture: The Internation Decade for Water 2005-2015, Session Water and Cultural Diversity, Statement to the Ministerial Conference, 3rd World Water Forum, 22 March 2003).*

Water is the life of all living things in the world. Water is necessary from insects to human beings. Without water nobody can live. In our solar system except our earth water is not available in the other plants. In ancient times nobody could understand about the value and necessarily of water as like today. Because during that time there was not any big industry, human population was also not increase like today. Each and everybody could use water when they want to use. But time has changed and attitude towards water is also change. Today all human beings especially in 3rd and 4th world countries are fall in victims of water crisis.

People of these countries are not able to use safe drinking water as they wise. Development of science and technology and also rapid industrialization create a lot of problem in water and its use.

The term 'Pollution' has a variety of meanings for different people. To some, it means only the discharging of untreated waste water, or sediments from urban development, to others, introduction of pesticides and agricultural chemicals. To sportsman, pollution may be water temperature too high for sports, fish to survive or massive fish kill resulting from toxic chemicals present in terms of algae and decaying plant growth. Water pollution is a global issue. According to the census report of 2000 it is known that 18 percent urban people and 45 percent rural people are not able to avail safe drinking water facility in the underdeveloped countries of the world. On the other hand, 8 percent urban and 31 percent rural people are not able to use safe water in the developing countries. In 21st century million people of the modern civilization are crying for safe drinking water. When the citizens of USA are use 500 liter and the citizens of United Kingdom is use 200 liter water in their daily life then the citizens of Zambia can use only 4.5 liter water averagely in their daily life. In 1992, the United Nations General Assembly proclaimed March 22 as World Water Day with the goal to inspire action and encourage understanding of the need for more responsible water use and conservation. Vigorous action taken by all sectors, including individuals and communities, will help ensure that there is water for all. India also has joined other countries across the globe to deal with this huge problem. In 2006 Human Development Report (HDR) called for a Global Action Plan under G-8 leadership to resolve a growing water and sanitation crisis that causes nearly 2 million child deaths every year. We never know the worth of water till the well is dry.

Importance of the Study:

Water is essential for survival of all living beings and also for socio-economic development of households, communities and nations all over the world. It is also necessary to maintain and enhance biodiversity and quality of environment. It is estimated that it accounts for 4 percent of the world's fresh water resources. Due to lack of safe drinking water it is trying to preserve rain water and also trying to purify salted sea water to use as drinking water. It is known that if we cannot free water from pollution in due time then one human civilization will destroy. The famous poet Coleridge once said on water, "Water water everywhere, nor any drop to drink" (Coleridge, *The Rime of the Ancient Mariner, June, 1970*). Keeping the above scenario in mind the researcher makes an attempt to see how water creates a crisis in human civilization.

Objectives of the Study:

The objectives of the study are—

1. To study about the necessity of water,
2. To study about the role of Government preservation and supply of safe drinking water.

Methodology:

Data:

The present study is based on secondary sources. The data were collected from different books, journals, census report and website.

Discussion and Findings:

Necessity of Water:

Safe drinking water influences the quality of health and productivity. Water is called as "Indrajal" in mythology — the nature's gift through rainfall, it not only satisfies the thirst of human beings but also gives food and sustain life of human beings, plants and animals. The great civilizations in ancient times were settled on the bank of the rivers such as Indus, Nile, and Tigris-Euphrates etc. where their societal and cultural life based on it. It is come to know from the ruins of the ancient civilizations that during that period people were agriculturalist and they flow water from the rivers through the irrigation system.

Provision of safe drinking water is considered today as fundamental to good governance to promote good health and welfare of the people. Population and urbanization process is rapidly increased in modern times. Most of the rural people are migrate from their original inhabitant and started to lived the urban area for which level of water become decreases. Each year, more than one billion of our fellow human beings, have little choice but to resort to using potentially harmful source of water. This is crisis which kills over 3,900 children every day. People have a right to life and the resources that sustain it, such as water. The necessity of water to life is so important that water has been accepted as a natural right. The United Nations' Human Rights statement on right to water says, "The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" (*The UN Committee on Economic, Social and Cultural Rights, Nov., 2002*). An adequate amount of safe water is necessary to prevent death from dehydration, reduce the risk of water-related disease and provide for consumption, cooking, personal and domestic hygiene requirements. Water for development is an economic function and is related to production activities which fulfill private interests such as irrigation for agriculture, hydroelectricity, or industry. However, water for development consumes the largest quantity of water from all surface and ground water resources and consequently is largely responsible for creating problems of local scarcity and also of pollution.

The availability of water is a concern for some countries. In high income areas of cities in Asia, Latin America and Sub-Saharan Africa people enjoy access to several hundred liters of water a day delivered into their homes at low prices by public utilities. On the other hand, slum dwellers and poor households in rural areas of the same countries have access to much less than the 20 liters of water a day per person required to meet the most basic human needs. Women and young girls carry a double burden of disadvantage since they are the ones who sacrifice their time and their education to collect water. A recent study of water supply in seven cities published by Economic and Political Weekly shows that on an average, only about 18 percent of households have access to water on tap rounded the clock, while the majority get water for a few hours once or twice in a day or only once in two days. All of these studies show how much necessity of water in human life. If someone can access huge amount of water in their day to day life and others who live in slums areas wandering one place to another in search of a single drop water.

Role of Government and NGOs':

Water is a unique chemical essential for survival. But due to chemical and biological pollution of water bodies create lots of problem in the present world. At the Rio Summit 1992, pollution of fresh water resources had taken unfortunately a back seat as developed nations mostly focus on stringent regimes to dispose of toxic chemical and nuclear waste. The social activist Vandana Shiva observed, "In India industry seems to have more leverage to pollute than before. It is in fact trying to use the liberalization drive to get itself free from environmental regulations too. The Baltic Sea, for instance, is literally too dying with radioactive waste, fertilizers, toxic chemicals and heavy metals being poured untreated into its brackish waters" *(India Today, 1992).* Access to safe water is now a right, as per the resolution of the 29th Session of the UN Committee on Social, Cultural and Economic Rights, November, 2002. The human right to water focuses on the amount of water necessary for basic human needs, which is about 50 liters per person per day. The right to drinking water does not refer to general issues linked to environmental protection or integrated management of resources.

India as a country with abundance of natural resources is blessed with large resources in terms of water. In India, the right to safe drinking water is part of the right to life which is contained in Articles 21 under fundamental rights in the Constitution. The primary allocation of water for human consumption has also been established through the National Water Policies, and large investments have been made in infrastructure to provide water for drinking, and for domestic use. The Constitution of India, National Water Policies and Five Year Plan give importance to provide safe drinking water to 480 million people who do not have access. India has been ranked 133rd among 180 counties for its poor water availability of 1880 cubic meters per person annually by the United Nations.

Drinking water supply and Sanitation are the subjects of State Governments. Since, the first five year plan, both the Central Government of India and the State Governments have substantially invested about Rs. 55,000/- core in rural water supply sector for providing potable water supply to the rural people. In 1972-73 the Government of India introduced "Accelerated Rural Water Supply Programme" (ARWSP) to assist the States and the Union Territories with 100 percent grants-in-aid to implement drinking water supply schemes in villages. The entire programme called the National Drinking Water Mission (NDWM) was introduced as one of the five Missions in the social sector in 1986. The State Government are implementing ARWSP through their departments, namely, Public Health Engineering Department (PHED), Panchayat Raj Engineering Department (PRED), Rural Development and Panchayat Raj Department. Drinking water supply is one of the six components of Bharat Nirman, which has been conceived as a plan to be implemented in four years, from 2005-06 to 2008-09 for building rural infrastructure. The Department of Drinking Water Supply, Ministry of Rural Development, Government of India has initiated steps to ensure that the targets of the rural drinking water component of Bharat Nirman are met within the specific time frame. The Drinking Water component of Bharat Nirman is implemented through ARWSP. The State Governments and Union Territories have been asked to prepare their Action Plans. The progress (Drinking Water Supply) of Barat Nirman is being monitored periodically.

Conclusion:

From the above discussion it is come to know that water is essential part of all living objects. The earth is surrounded by 70 percent water. But all water is usable as safe drinking water. It is estimated that nearly 60,000 chemicals used in consumer products, industries, agriculture and commerce. The industries produce quite a large number of hazardous waste in liquid, gaseous and solid forms which are discharge into seas, rivers and streams despite guidelines issued by the Ministry of Environment. The Government of India implements many scheme to provide safe drinking water for urban and rural areas. But the mission is not completely successful due corruption. However, water is the life of all. If we do not take any steps to preserve water then our future generation will fight only for water not for soil or oil.

References

1. Asthana. D. K. and Asthana, Meera, *A textbook of Environmental Studies,* New Delhi: S. Chand & Company. 2009.print.
2. Bezboruah, Dr. Aditi, *Pani aru Ami (Water and We)*, Jorhat: Assam Science Society, 2004. print.
3. India Today, Aroon Purie for Living Media India Limited, 1992
4. Katiyar, V. S., *Environmental Concerns: Depleting Resources and Sustainable Development"*, Jaipur: Pointer Publishers. 2008.print.
5. Misra, Anurag, *YOJANA*, New Delhi: Yojan Bhavan, September 2007.print.
6. Mukherjee, Dhurjati, *Water Crisis and Human Security: Global Efforts Imperative*. In: "Kurukshetra A Journal on Rural Development", Kumar Kapil, New Delhi: Ministry of Rural Development. May 2007. print.
7. Pangare, Vasudha and Pangare, Ganesh, *Implementing the Right to Water*. In: "YOJANA", Misra, Anurag. New Delhi: Yojana Bhavan, September, 2007.print.
8. Ram, Dr. P. Siva, *Government Initiatives in Rural Water Supply: Programmes, Performs and Bharat Nirman*. In: "Kurukshetra A Journal on Rural Development", Kumar Kapil. New Delhi: Ministry of Rural Development. May 2007. print.
9. Reddy, K. Purushotham; Reddy, D. Narasimha, *Environmental Education*, New Delhi: Neelkamal Publications Pvt. Ltd. 2003.print.
10. Salgare, S. A., and Acharekar, R. N. *Effect of Industrial Pollution on the Growth Performance of Some Plants of Kalu River*. In: "Environmental Protection" (Ed.), 8. Chaudhary, Vimlesh, Jaipur: Pointer Publishers, 2000.print, p. 148
11. Swarup, R.; Mishra, S. N.; Jauhari, V. P. *Environmental Pollution and Human Habitation*, New Delhi: Mittal Publications. 1992.print.

Web link:

1. http://www.safewater.org/PDFS/knowthefacts/Human_Rights.pdf

THE END

ARTICLE

8

THE EFFECT OF COUNTERFORCE EXERCISES ON LEG AND BACK STRENGTH OF MIDDLE DISTANCE RUNNERS

Atul Kumar Gupta[*] & Dr. Krishna Kant Sahu[1]
Research Scholar[*] & Associate Professor[1], Amity University, Noida, INDIA

Abstract:

In the promotion of sports performances can be developed by improving the basic fitness factors through counterforce exercise. Leg and back strength is one of the components of physical fitness which can effect by the counterforce exercises. The present study was undertaken on 32 male runners of Amravati (M.S). Who were equally divided on random basis as experimental group (N=16) and control group (N=16). Leg and back strength was measured using leg and back lift dynamometer before commencement of training programme.

During the experimental period the subjects belonging to the experimental group were given counterforce exercises for a period of eight week. Final test was conducted after eight weeks. The data shows a significant improvement in the leg and back strength ability test as a result of counterforce exercises practices. Significant difference is noticed between post test data of the experimental and control group. Thus it may be concluded with justification that counterforce exercises for eight weeks bring significant changes in leg and back strength ability of middle distance runners.

Introduction

Running is a means of terrestrial locomotion allowing humans and other animals to move rapidly on foot. It is simply defined in athletics terms as a gait in which at regular points during the running cycle both feet are off the ground. This is in contrast to walking, where one foot is always in contact with the ground, the legs are kept mostly straight and the canter of gravity vaults over the stance leg or legs in an inverted pendulum fashion. Studies are in evidence showing significant influence of counterforce exercises training program on physical fitness and leg and back strength which is known to be very essential factor of sports performance.

The present study was undertaken to find out the effect of counterforce exercises on leg and back strength of middle distance runners who are seemed to be in budding condition where the effect of exercises will be clearly noticed.

Materials and Methods

For the study,32 middle distance male runners belong to Amravati (M.S) were selected on random basis as the subjects for this study. Out of 32 subjects 16 selected as experimental group on random basis where remaining 16 were studied as the subjects of control group.

The experimental group was assigned counterforce exercises as experimental treatment. The counterforce exercises training program were performing for app.1- 1/2 hour every day except Sunday and the subjects did not engage in any other exercise during experimental period, whereas, the control group enjoyed their usual daily routine during the experiment. Leg and back strength ability of the subjects were tested by leg and back lift dynamometer.

Test Administered

Leg and back Strength test was administered in lab. Test was conducted early in the morning. The total administration process of the test and its importance was thoroughly explained to all the subjects.

Leg Strength Test:

The subject was asked to stand with feet 6 inches apart from each other. The bar was held in the canter at the level of pubis with palm facing downward. The knees were flexed between 115and 125 degrees. The subject was asked to lift the bar or dynamometer upward so as to make his knee nearly straight at the end of the lift. The chain was adjusted so that a maximum lift was obtained. Three trials were allowed to the subject and highest reading was recorded.

Back Strength Test:

The subject took the standing position with trunk lightly flexed (10-15) forward at the hip, holding the dynamometer bar, one hand from above and the other hand from below the bar. This was achieved by adjusting the bar at a level just below finger tips when the subject stood erect with hand on the front of thigh. The hands were spread at the width of the shoulders. The body weight was balanced on the feet which were placed about six inches apart. The knees and the back were kept straight throughout the lift and the lift was steadily upward without jerking. The subject

was asked not to lean backward on the heels. Three trials were allowed to the subject and highest reading was recorded.

Statistical Method

On the result of leg and back strength test ability the control and experimental group were equated on the basis of respective mean and standard deviation. Analysis of variance between two group ('T'-test) statistics was employed as the statistical treatment in order to find out the existence of significant differences if any between the pre-test data of the experimental and control group and between pre and post-test of an experimental as well as control group and between the post test result of control and experimental group.

Result & Analysis

Table 1: Comparison effect between pre and post test data of counterforce exercises practices of experimental and control group on leg strength.

S No.	Variables	Group	Mean Score		Difference of Mean	S.E Mean Diff.	T Value	Significance Level
			Pre	Post				
1	Leg Strength	Experimental N = 16	31.50	41.37	9.87	2.693	3.665	0.05
2	Leg Strength	Control N = 16	31.25	31.75	0.50	4.475	0.111	0.05

Table 2: Comparison effect between pre and post test data of counterforce exercises practices of experimental and group on back strength.

S No.	Variables	Group	Mean Score		Difference of Mean	S.E Mean Diff.	T Value	Significance Level
			Pre	Post				
1	Back Strength	Experimental N = 16	28.81	40.12	11.31	1.83	6.18	0.05
2	Back Strength	Control N = 16	28.75	29.25	0.5	0.167	0.298	0.05

Table 3: Comparison effect between post test data of counterforce exercises practices of experimental and control group on leg strength.

S. No.	Variables	group	Mean-score post test	Diff. of Mean	S.E Mean Diff.	T value	Significance Level
1	Leg Strength	Experimental N=16 And Control N=16	41.37 31.75	9.62	2.269	4.230	0.05

Table 4: Comparison effect between post test data of counterforce exercises practices of experimental and control group on back strength.

S. No.	Variables	Group	Mean-score post test	Diff. of Mean	S.E Mean Diff.	T value	Significance Level
1	Back Strength	Experimental N=16 And Control N=16	40.12 29.25	10.87	1.688	6.429	0.05

Table 5: Comparison between the pre-test data of experimental and control groups on leg strength.

S. No.	Variables	Group	Mean-score pre test	Diff. of Mean	S.E Mean Diff.	T value	Significance Level
1	Leg Strength	Experimental N=16 And Control N=16	31.50 31.25	0.25	4.704	0.053	0.05

Table 6: Comparison between the pre test data of experimental and control group on back strength.

S. No.	Variables	Group	Mean-score pre test	Diff. of Mean	S.E Mean Diff.	T value	Significance Level
1	Back Strength	Experimental N=16 And Control N=16	28.81 28.75	0.06	1.82	0.032	0.05

Discussion of Findings

Table 1: revealed that the mean score of post test data of experimental group (M=41.37) in leg strength is higher than that of pre test data (M=31.50), 'T' value (t=3.665) showed significant difference at .05 level of confidence at 38 degree of freedom. No significant difference is noticed between pre post test data of control group (t=0.111).

Table 2: revealed that the mean scores of post test data of experimental group (M=40.12) in back strength is higher than that of pre test data (M=28.81), 'T' value (t=6.18) showed significant difference at .05 level of confidence at 38 degree of freedom. No significant difference is noticed between pre post test data of control group (t=0.298).
Counterforce exercises are brings important physiological changes accompanied with leg and back strength ability of the experimental group showed significant improvement than of their ability.
Further with the subject belonging to the control group who were not associated with experimental treatment rather led their usual to normal life, no changes in their leg and back strength ability between pre and post result were noticed.

Conclusion

Thus it may be concluded with justification that counterforce exercises undertaken for this study for eight weeks duration result in development of back and leg strength of middle distance runners. Such types of counterforce exercise may be taken in account of strength and endurance development programme to develop the leg and back strength of the individual sports man where the alternate method of such development is restricted in one or other ways. It may be also desirables without any injury or without increases on muscle mass.

References

1. Caputo F. and Denadai B. (2004). Effects of aerobic endurance training status and specificity on oxygen uptake kinetic during maximal exercise. *European journals of applied physiology*, 93(1-2): 87-95.
2. Dunn. Steven. E. (1980). Changes in aerobic capacity strength and body comparison with timed calisthenics, *Dissertation abstract international*, 40, 53 63-A
3. Eicher Tom. (1975). Improving sprinting speed through strength training, *New Studies in Athletic Journal,* 40-45.
4. Elliott KJ, Sale C. (2002) Effects of resistance training and detraining on muscle strength and blood lipid profiles in postmenopausal women, *Britain Journal of Sports Medicine*. 56-57.
5. Hignmore. George. (1956). Factorial analysis of athletics ability, *Research Quarterly*, 27:1, 1-11
6. Koller. Louis. F. (1942). The relationship of quickness of bodily movement to success in athletics, *Research quarterly*, 13:2, 146-155.

THE END

ARTICLE

9

MISHING'S APONG – AN INTANGIBLE CULTURAL HERITAGE OF ASSAM

Babita Phukan Borkotoky*, Mridula Neog[1] & Iswar Chandra Barua[2]
*[1]Kakojan College, Jorhat & Assam Agricultural University, Jorhat, INDIA

Abstract:

"Apong", the fermented rice product of Mishing tribe plays a significant role in their socio cultural life. Mishings usually prepare two varieties of *Apong* and use a number of plant species in making the starter culture for rice beer fermentation. This paper documented 51 species of plants which are used by Mishings in their starter culture, the "Epop" or "Epoppitha". Three species of microflora belonging to *Saccharomyces* and one species both of *Mucor* and *Rhizopus* were detected in these starter cultures. Chemical analysis revealed that both the *Apong* varieties contained as much as 5% alcohol, however, "Nogin Apong" possessed higher calorific value than "Po:ro Apong". Both the variety of *Apong* possessed nearly same number and kind of free amino acids. These unfiltered and unpasteurized "life" beers possessed remarkable territorial identity, compared to commercially sold wine or "dead" beers, and scope for registration under Geographical Indications of Goods Act.

Introduction

Beers are the oldest and less formal form of alcoholic beverages[1]; beer brewing is one of the integral parts of the tribal culture of cereal dependent regions of the world. In wine marketing regulations on "denomination of origin" embracing market intelligence, marketing strategy and collective communication have been considered as fundamental steps[2], where economy of scope at the territorial level could be realized in the use of collective assets such as landscape, cultural heritage and local know-how[3]. The knowledge and skill developed by traditional practices, availability of inputs that have geographical and edapho-climatic influence and above all the socio-cultural integrity might be the most unavoidable factors that bestowed territorial identity of ethnic beverages.

Like all other aboriginal tribal communities of Northeast (NE) India, preparation and consumption of rice beer is an intrinsic part of the diet of the Mishing tribe, the second largest tribal group of Assam, They named the beverage as "Apong". It plays a significant role in socio cultural life of the tribe. It is associated with almost all the important occasions like ritual ceremonies, festival, marriages and even death and cremation ceremonies. There are also reports of rice beer being used for medicinal purposes. Mishings prepare their indigenous alcoholic beverages at home using round to flattened solid ball of mixed dough inocula or starter called "Epop" or "Epoppitha". Like other tribal communities of NE India, Mishings also use a variety of plant species in starter culture preparation processes which are believed to add intoxicating property, taste and essence and increase great epidemiological effect of such isolates to human health[4,5]. Undoubtedly, this has been an intangible cultural heritage of Assam, the wealth of knowledge and skill are being transmitted from one generation to the next. The social and cultural values of this transmission are rather important in maintaining quality, peculiarity and territorial identity of *Apong*.

Mishings usually prepare two varieties of *Apong* which differ slightly in taste, colour and method of preparation. The *Nogin Apong*, the rice beer proper is whitish in colour and fermented from pure boiled rice, whereas, the *Po:ro Apong*, popularly known as *Saimod* is more transparent than *Nogin Apong* and has ash or brown colour due to its alkaline preservative base added to the boiled rice. Ethnically, Mishings are Mongoloid and belong to Indo Tibetan group[12] and possess mythological, linguistic and institutional affinity with *Adi* and *Nishi* tribes of Arunachal Pradesh[13]. Mishings display their closest rapport with the mighty river Brahmaputra, and accordingly most of their settlement areas are situated along the islands and banks of the river from Golaghat to Demaji and Tinsukia districts.

Though the consumption of rice products are integral part of tribal culture of Assam, the systematic research of fermented food of ethnic tribes of this region is extremely meager; a few account largely deal with wild plants used by different tribes[5,8,9] and a little specifically on Mishings[10,11,12] that had explored plant species used for starter culture preparation, however, the biochemical as well as microbiological investigation got no importance in these works. A recent publication pitched some light on *Po:ro Apong* (*Saimod*) of Mishings[13]; while it paid very reluctant importance on the plants used for preparation of the starter culture. Hence, the present study has embraced the ethnobotanical investigation of starter culture of fermented rice products used by Mishing tribe, isolation of microflora of starter culture involved in fermentation and chemical assessment of essential compounds in fermented rice products.

Methodology

Survey: Extensive and repeated survey was carried out in Mishing dominated areas of Jorhat district of Assam that have been common practice of *Apong* preparation in their livelihood in and around their villages. Study materials, viz. prepared starter culture, the *epop* or *epop pitha* along with prepared *Apong,* have been collected for laboratory study mostly from five villages, namely Sirum, Budubari, Boloma, Bhomoraguri, and Arunamukh of the study area. Plant samples were collected during the months of April, May and June in 2011 and 2012, as during these months there is no heavy rain which makes easy accessibility to jungles and forest areas. All the plant species used in starter culture were collected. Herbaria were prepared from all voucher specimens by following standard procedure[14]. Plants were identified after critical morphological studies done at field condition and at laboratory and by comparing the characters with local "Floras", monographs and relevant literature and consulting the "Weed Herbarium" of Assam Agricultural University, Jorhat and Kanjilal Herbarium of Botanical Survey of India (Eastern Circle), Shillong. The collected specimens were documented and preserved in the Herbarium of Kakojan College, Jorhat.

Microbiological investigation: Microorganisms involved in fermenting rice were isolated from *Epop* by serial dilution technique. Presence of Enterobacteriaceae was tested by using selective violet red bile glucose agar media (HiMedia M581) and incubating at 30^{o}C for 48 hours. For lactic acid bacteria deMan, Rogosa and Sharpe (MRS) agar media supplemented with 1% Calcium Carbonate was used. Petri plates were incubated at 30^{o}C for 24 to 72 hours[15]. For yeast and mould Sabourd Dextrose Agar media (pH 5.6) supplemented by streptomycin 10µg /ml was used; the plates were incubated at 28^{o}C for 48hours. Total viable cells were determined by using plate count agar (Hi Media M091A) and incubated at 30^{o}C for 48 hours. Colony characters, microscopic appearances, gram staining and catalase test comprised initial characterization of bacterial isolates[16]. Yeast isolates were identified by colony character, microscopic appearance and germ tube test[17]. Moulds were identified by colony character, microscopic appearance and reproductive structure. Microbes were identified at least to the group or lowest possible genera.

***Biochemical investigation*:**

Crude protein- Total Nitrogen was estimated as per Kjeldel method and converted to protein values by multiplying nitrogen percentages with the factor 6.25 by following AOAC (2005) method[18].

Crude fat content:- Crude fat was obtained by continuous extraction of each sample in a soxhlet apparatus using petroleum ether as solvent . The solvent was then distilled completely. The oil was dried, weighed and percent oil was calculated by AOAC (2005) method[18].

Total Carbohydrat:-Determination of total carbohydrate was done by Anthrone method[19].

Alcoho:- Determination of percent alcohol was done by simple distillation and hydrometry method[20].

Free Amino acids:- Qualitative estimation of free amino acids was determined by paper chromatography, using Whatman No. 1 chromatography paper. Butanol, Glacial Acetic Acid and distilled water were used as solvent in 12 : 3 : 5 ratio. Amino acids were identified by colour and comparing the Rf value with that of standard[21].

Acidity:- pH of the rice beer samples were measured by digital pH meter (type C- 307, Insif, India) calibrated with standard buffer solution.

Calorific value:- Total calories of rice beer samples were determined by AOAC method by summing up the multiplication values of crude protein, crude fat, total carbohydrate and percent alcohol with the number 4, 9, 4 and 7, respectively.

Results and Discussion

The ethnobotanical investigation revealed that as many as 51 species, belonging to altogether 39 genera and 31 families of higher plants, were utilized by the Mishings in preparing the starter cultures. However, priority has been given to different plant species and proportion of plant parts for determining the strength to act as intoxicants, bitter or sweet taste as well as for imparting different flavours of the final product. Most of the plant species used in starter culture was found to be medicinally important (Table-1). This finding depicted the floristic richness of the region, where Mishing people used to settle, and their intrinsic community effort in conserving these species in their growing habitat. The selection of these species definitely was a result of long traditional experience sharing processes; obviously, it proved the close proximity of Mishings with the nature.

Study also revealed that generally women were involved in preparation of *epop* and *Apong.* Collected plants and plant parts were sun-dried for at least 2-3 days and grounded in wooden grinder. The greenish powder was then mixed with water soaked rice coupled with a few *epop*s from old stock (as a source of microbial consortium) and ground further. Adding required amount of water to this dough, small spherical or ovoid cakes (2-5 cm in diameter) were prepared. The cakes were then kept in bamboo frame about 1.5m above the fire place of their kitchen for about 3 days for incubation and then sundried for 2-3 days. After complete drying the cakes (starter culture) became hard and whitish in colour with greenish mosaic tinge; these *epop*s can be stored for about two months.

In the entire study area it was seen that to prepare *Apong,* tightly cooked fresh rice (using lesser amount of water) was used. Rice was thoroughly mixed with powered starter culture (usually 4-8 *epop*s per kg of rice) and kept in clean pots (usually earthen pots) plugging with rice straw or fern leaves. After 3-4 days *Apong* (*Nogin Apong*) accumulated in the pots from the fermented rice mixture and attained the actual stage for drinking. While, in case of *Po:ro Apong,* ash of specially burnt rice husk with hay was mixed with cooked rice prior adding the starter culture till the rice became black in colour. Keeping in the pots for 15 to 20 days, this mixture is kept in a conical bamboo made frame lining with banana leaves and then drinking water was poured through the fermented rice mixture; the filtrate (*Po:ro Apong*) was collected in earthen pots.

The laboratory study revealed that, microorganisms isolated from the starter culture of *Apong* possessed three species of *Saccharomyces* and one species both of *Mucor* and *Rhizopus*. After incubation, no growth of bacteria belonging to the family Enterobacteriaceae and Lactic acid bacteria group were observed in the culture plates. This finding has indicated that the fermentation process was dependent on yeast and moulds and was free from the involvement of bacteria. Total number of viable cells (yeast and moulds) per milliliter of original culture sample was found to be 118×10^7 (Table-2).

The biochemical study has shown that, the tested samples of *Apong* were mild alcoholic beverage (Table-3). Both the varieties of *Apong* i.e. *Nogin Apong* and *Po:ro Apong* contained 5% alcohol, however, *Nogin Apong* was richer in carbohydrate, protein and fat content; that might be due to the lack of filtration process practiced during preparation; accordingly, *Nogin Apong* possessed high calorific value than *Po:ro Apong*. Presence of nearly 11 numbers of free amino acids was observed in both the types of *Apong*, out of which, 5 numbers were proteinogenic and the rest were non proteinogenic amino acids (Table-4). It was observed that the quality of amino acids were almost same in both the variety of *Apong*; however, depending upon the plant species used in preparing the starter culture there is every possibility of variation in the number of amino acids in the beverage. Above all, the detection of essential amino acid 'isoleusine' possessed great significance and added a novel dimension to the *Apong*, as essential amino acids can not be created from other compounds by the human body and need to intake as food[22].

Conclusion

The starter culture of the fermented rice beverage *Apong* of Mishing tribe of Assam required as many as 51 plant species. The microbiological investigation revealed the presence of 118×10^7 numbers of viable cells of yeast and moulds. The biochemical analysis of two different varieties of *Apong* confirmed the presence of only 5% alcohol and as many as 4 free proteinogenic and 7 number of non proteinogenic amino acids, along with an essential amino acid 'isoleusin'. This alcoholic beverage possessed tremendous scopes of commercial exploitation, if further scientific support is paid mainly to quantify the ingredients and, recognition of proper plant species for making the starter culture, accurate isolation and identification of microorganisms involved in fermentation, quantify the dose of administration and maintain hygienic condition in preparation. Such an attempt is expected to have positive impact on the health and welfare of the people especially of the lower income group of this region. These unfiltered and unpasteurized "life" beers possessed remarkable territorial identity, compared to commercially sold wine or "dead" beers, and scope for registration under Geographical Indications of Goods Act.

Acknowledgement

Authors are thankful to UGC for financial assistance and College Authority of Kakojan College, Jorhat for providing facilities. They are also thankful to Mr B. Goswami of Assam Agricultural University for helping in biochemical analysis.

References

1. Wikipedia, History of beer (29.01.2014)
2. Rocchi B & Gabbi M, Terretorial identity as a competitive advantage in wine marketing: A case study, *J. Wine Research* 24(4)(2013) 291-310.

3. Polidori R & Romano D, Dinamia economica strutturale e sviluppo rerale endogeno: il caso del Chianti Classico, *Rivista di Economia Agraria* 52(4)(1997) 395-427.
4. Sarma HK, Isolation and characterization of yeast strain from indigenous starter culture for alcoholic fermentation. In *Microbial Diversity: status and potential application*, edited by SC Tiwari & GD Sharma, (Scientific Book Centre), Guwahati, 2002, 85-97.
5. Tanti B, Gurung L, Sarma HK & Buragohain AK, Ethnobotany of starter culture used in alcohol fermentation by a few ethnic tribes of Northeast India, *Indian J Traditional Knowledge,* 9(3) (2010) 463-466.
6. Das BM, *Microevolution,* (Concept Pub. Co.), New Delhi, 1981.
7. Mipun J, *The Mishings (Miris of Assam) Development of a new lifestyle*, (Gyan Publ. House), New Delhi, 2000.
8. Gogoi P & Boissya S, A method for preparation of beer from rice (country liquor) used by people of Mongolian origin residing in the state of Assam, India. *Anthropos* 79 (1984) 248-250.
9. Roy B, Kala CP, Farooque NA & Majila BS, Indigenous fermented food and beverages: A potential for economic development of the high altitude societies. *Uttaranchal J Human Ecology* 15(1) (2004) 45-49.
10. Singh J, Bhuyan TC & Ahmed A, Ethnobotanical studies on the Mishing tribes of Assam with special reference to food and medicinal plant, *J. Econ. Taxon. Bot. Addi. Ser*.12 (1996) 350-356.
11. Baruah M & Kalita D, Ethnomedicine used by *Mishing* tribes of Dibrugarh district, Assam, *Indian J Traditional Knowledge,* 6(4) (2007) 595-598.
12. Das AJ, Deka SC & Miyaji T, Methodology of rice beer preparation and various plant materials used in starter culture preparation by some tribal communities of North-East India: A survey, *International Food Research J,* 19(1) (2012) 101-107.
13. Karding D, Deori K, Sood K, Yadav RNS, Bora TC & Gogoi BK, Evaluation of nutritional and biochemical aspects of *Po:ro apong* (*Saimodl*)- A home made alcoholic rice beverage of *Mishing* tribe of Assam, India, *Indian J Traditional Knowledge,* 11(3) (2012) 499-504.
14. Radford AE, *Fundamentals of plant systematics,* (Harper International), New York, 1986.
15. Sahliya I, Joshi SR, Bhagobaty RK & Kumar R, *Thungrymbai*- A traditional fermented soybean food of the ethnic tribes of Meghalaya, *Indian J Traditional Knowledge,* 8(4) (2009) 559-561.
16. Cappuccino JG & Sherman N, *Microbiology, A Laboratory Manual* 6th Edition, Pearson Education, 2002.
17. Ellis D, Davis S, Alexiou H, Handke R & Bartley R, *Description of Medical Fungi* 2nd Edition, (Mycology Unit, Women's and children Hospital. School of Molucular & Biomedical science, University of Adelaide), Adelaide, 2007.
18. AOAC, *OFFICIAL METHOD OF ANALYSIS* 18TH EDITION, WASHINGTON DC, 2005.
19. Tregelyan WE & Harrison AS, Studies on yeast metabolism. I. Fractionation and microdetermination of cell carbohydrate, *Biochem J,* 50 (1952) 298.
20. Amerine MA & Ough GS, *Wine and must analysis*, (John Wiley & Sons), New York, 1974.
21. Swarup N, Arora S & Pathak SC, *Laboratory Techniques in Modern Biology* 2nd revised and enlarged Edition, (Reprinted 1992, Kalyani Publishers), New Delhi. 1986.
22. Amino acids – Wikipedia the free encyclopedia. *en.wikipedia.org/wiki/Amino-acids.*

Table- 1 List of plant species with botanical names, family, vernacular names, parts used, medicinal use and food supplement.

SL. No	NAME	FAMILY	VERN. NAME	PARTS USED	M. U.	F.S.
1	*Argyreia nervosa* (Brum.f.) Bojer	CONVOLVULACEAE	Gakhir paat (M)	Leaves	✓	
2	*Artocarpus heteophyllus* Lamk.	MORACEAE	Kathal(A); Belang (M)	Leaves and receptacle	✓	✓
3	*Canabis sativa* L.	CANNABIACEAE	Bhang (A,M)	Leaves	✓	
4	*Centella asiatica* (L.)Urban	APIACEAE	Manimuni(A); Atanmanimuni(M)	Whole plant	✓	✓
5	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	LAURACEAE	Nagadalchini(A); Seerang-asing, Kutuk kartak (M)	Leaves	✓	
6	*Cinnamomum verum* (F. Ham.) Nees et Eberm.	LAURACEAE	Tej paat (A, M)	Leaves	✓	
7	*Clerodendrum indicum* (L.) O. Kuntze	VERBENACEAE	Akolbih (A); Akolbiring (M)	Leaves	✓	
8	*Clerodendrum colebrookianum* Walp.	VERBENACEAE	Nephaphu (A); Pokong-pakbong (M)	Leaves	✓	✓
9	*Clerodendrum viscosum* Vent.	VERBENACEAE	Dhopat-tita (A), Ghato-paat (M)	Leaves	✓	
10	*Costus specious* (Koeng) Sm.	ZINGIBERACEAE	Jamlakhuti (A, M)	Leaves	✓	
11	*Croton caudatus* Geisel	EUPHORBIACEAE	Ghae-lewa (A), Bisapaat, Lata-mahudi (M)	Leaves		
12	*Croton joufra* Roxb.	EUPHORBIACEAE	Gos mahudi(M)	Leaves	✓	
13	*Dicranopteris linearis* (Burm.) Under.	GLEICHENIACEAE	Prithibi dhoka (A)	Leaves	✓	
14	*Dioscoria hamiltonii* Hook. f.	DIOSCORIACEAE	Kunduli lota (M)	Leaves	✓	
15	*Drimaria cordata* (L.) Wild. ex R & S	CARYOPHYLLACEAE	Lai zabori (A, M)	Whole plant	✓	✓
16	*Ficus curtipes* Croner	MORACEAE	Kothaluajari (A), Laghupaat (M)	Leaves	✓	✓
17	*Ficus hipsida* L. f.	MORACEAE	Tak-piang(M)	Leaves	✓	✓
18	*Hedyotis lineata* Roxb.	RUBIACEAE	Temena(A), Regon poper(M)	Leaves		
19	*Hedyotis auricularia* L.	RUBIACEAE	Bongali dorob (M)	Leaves		
20	*Hedyotis corymbosa* (L.) Lamk.	RUBIACEAE	Bonjalook(A, M)	Whole plant	✓	✓
21	*Hedyotis diffusa* Willd	RUBIACEAE	Bonjalook (A, M)	Whole plant	✓	✓
22	*Hydrocotyle sibthorpioides* Lamk.	APIACEAE	Ajjon manimuini (M) Haru manimuni(A)	Whole plant	✓	✓
23	*Jasminum* sp.	OLEACEAE	Da chi piri (M)	Leaves		
24	*Leucas indica* L.	LAMIACEAE	Doron (A,M)	Leaves	✓	✓
25	*Lygodium flexuosum* (L.) Sweet	LYGODIACEAE	Kopowdhekia(A); Mota kopowdhekia(M)	Leaves	✓	

26	*Lygodium japonicum* (Thunb.) Sw	LYGODIACEAE	Maiki kopow dhekia (M)	Leaves		
27	*Magnolia pterocarpa* Roxb.	MAGNOLIACEAE	Pansopa (A, M)	Leaves		
28	*Mazus rugosus* Lour.	SCHROPHULARIACEAE	Kansidaryia(A, M)	Whole plant	✓	✓
29	*Myrraya koengii* (L.) Spreng	MELIACEAE	Narasingha (A, M)	Leaves	✓	✓
30	*Palhinhaea cernua* (L.) Franco et Vasc.	LYCOPODIACEAE	Humhumia (A) Nagamamut (M)	Whole plant	✓	
31	*Paveta indica* L. ssp. *tomentosa* (Roxb. ex Smith) Hook.f.	RUBIACEAE	Chitalepo (M)	Leaves		
32	*Phlogacanthus curvifloras* Nees.	ACANTHACEAE	Titaphool (A) Titakosi (M)	Leaves	✓	
33	*Piper bettle* L.	PIPERACEAE	Paan (A, M)	Leaves	✓	
34	*Piper longum* L.	PIPERACEAE	Pipoli (A, M)	Leaves	✓	
35	*Piper nigrum* L.	PIPERACEAE	Jalook (A, M)	Leaves	✓	
36	*Psidium guajava* L.	MYRTACEAE	Madhuri (A, M)	Leaves	✓	
37	*Pteris critica* L.	PTERIDACEAE	Torang paat (M)	Leaves		
38	*Pteris semipinata* L.	PTERIDACEAE	Sipkathi dhekia(M)	Leaves		
39	*Saccharum officinarum* L.	POACEAE	Kunhiar (A) Tabat (M)	Leaves		
40	*Scoparia dulcis* L.	SCROPHULARIACEAE	Bonjalook (big) (A, M)	Whole plant	✓	✓
41	*Selaginella semicordata* (Wall. ex Hook et Grev.) Spring	SELAGINELLACEAE	Naga amut (M)	Whole plant		
42	*Solanum indicum* auct. non. L.	SOLANACEAE	Titabhekuri (A) Konebankow (M)	Leaves	✓	
43	*Solanum torvum* Swartz.	SOLANACEAE	Hatibhekuri (A) Titabankow (M)	Leaves		
44	*Sphaerostephanos unitus* (L.) Holttum	THELYPTERIDACEAE	Bihlongoni (A, M)	Leaves	✓	✓
45	*Spilanthes paniculata* DC.	ASTERACEAE	Suhani(A) Marchang (M)	Leaves	✓	✓
46	*Stephania japonica* (Thunb.) Miers	MENISPERMACEAE	Tubuki lota (A)	Leaves		
47	*Terminelia chebula* Retz.	COMBRETACEAE	Silikha (A, M)	Leaves	✓	
48	*Thunbergia alata* Boj.	ACANTHACEAE	Kawri lota (M)	Leaves		
49	*Vernonia cinerea* (L.) Less	ASTERACEAE	------	Whole plant		
50	*Zanthoxylum rhetsa* (Roxb.) DC.	RUTACEAE	Tejmuri (A)	Leaves	✓	✓
51	*Zingiber officinale* Rose	ZINGIBERACEAE	C.V. Moran-aada (A, M)	Leaves	✓	✓

A=Assamese; M=Mishing language; M.U.= Medicinal use ; F.S.= Food supplement

Table-2 Colony character, microscopic appearance and reproductive structure of microorganisms isolated from starter culture.

Sl. No.	Colony Character	Microscopic appearance and reproductive structure	Germ tube test	Micro-Organisms (identified)
1	Colonies were round, moist, convex, entire, white in colour and had smooth buttery appearance	Spherical cell, colourless and reproduced by budding process	Negative	*Saccharomyces* species
2	Colonies were small, moist, convex, round and white.	Cells elliptical, much longer than broad, reproduced by budding process	Negative	*Saccharomyces* species
3	Colonies were very small, round, convex and white in colour.	Cells were oval in shape. A large central vacuole was distinctly visible in the cell. Reproduced by budding.	Negative	*Saccharomyces* species
4	Rapidly growing yellow coloured colony, aerial hyphae were white, cottony and swarms over entire plate.	Hyphae of the mycelium were broad, non septate, coenocytic and much branched. Both terminal and intercalary yellow chlamydospores were seen in abundance. Yeast like chains of arthrospores were also present	Not applicable	*Mucor* species.
5	Rapidly growing white coloured fungus swarms over entire plate; aerial mycelium cottony and fuzzy.	Mycelium nonseptate, coenocytic and gives rise to straight sporangiophores that terminated with black sporangium containing a columella; root like hyphae(rhizoids) penetrated the medium.	Not applicable	*Rhizopus* species.

Table-3: Crude protein, total carbohydrate, crude fat, percent alcohol, pH and percent calorie value of Apong samples of Mishing tribe.

Sample	Biochemical Components (g/100 ml)					pH	% calorie
	Weight	Crude protein	Total carbohydrate	Crude fat	% alcohol		
Sample-1 Nogin apong	(1ml=1.02g)	0.98%	17.364%	0.1%	5%	3.4	109.276
Sample-2 Poro Apong	(1ml=1.03g)	0.336%	4.207%	0.05%	5%	4.3	53.612

Table-4 List of amino acids with respective Rf values and colour determined in Apong samples through paper chromatograph

Sl. No.	Rf value	Standard Rf value	Colour	Inference (Free Amino acid identified)
1	11	11	Blue	Hydroxylysine
2	22	22	Blue	Serine / Methionine sulphone
3	23	23	Light blue	Aspartic acid
4	30	30	Blue	S-Carboxy- Methyl cysteine/ Aminoadific acid/ Alanine
5	44.5	45	Brown	Tyrosine
6	49	50	Blue	Methionine/δ – Amino – n – valeric acid
7	65.7	67	Blue	Isoleucine
8	17.7	18	Blue	Citruline
9	27.6	28	Blue	Glutamic acid
10	40	40	Blue	α – Amino-n-buteric –acid
11	53.2	53	Blue	Σ - Amino-n-Caproic acid
12	86.8	---	Blue	Unidentified

THE END

ARTICLE

10

UNIT DOSAGES FORM TABLET: AN OVERVIEW

Shashank Tiwari[*] & Dr. S.P. Mahapatra[1]
[*]Research Scholar, Department of Pharmacy, Monad University, INDIA
[1]Assistant Professor, Department of Pharmacology, S.S.Medical College, INDIA

Abstract:

The most common method of drug delivery is the oral solid dosage form, of which tablets and capsules are predominant. The tablet is more widely accepted and used compared to capsules for a number of reasons, such as cost, tamper resistance, ease of handling and packaging, ease of identification, and manufacturing efficiency. Over the past several years, the issue of tamper resistance has resulted in the conversion of most over-the-counter drugs from capsules to predominantly all tablets.

Introduction

Dosages Form:

"Dosage forms are the means (or the form) by which drug molecules are delivered to sites of action within the body."

Need for the dosage form:

- Accurate dose.
- Protection e.g. coated tablets, sealed ampules.
- Protection from gastric juice.
- Masking taste and odour.
- Placement of drugs within body tissues.
- Sustained release medication.
- Controlled release medication.
- Optimal drug action.
- Insertion of drugs into body cavities (rectal, vaginal)
- Use of desired vehicle for insoluble drugs.

Classification of Dosages form:

The dosages form can classified in to two types, i.e Route of administration and Physical form.

Route of Administration:

A route of administration in pharmacy is the path by which a drug is taken into the body.

Physical Form:

The physical from of drug which can

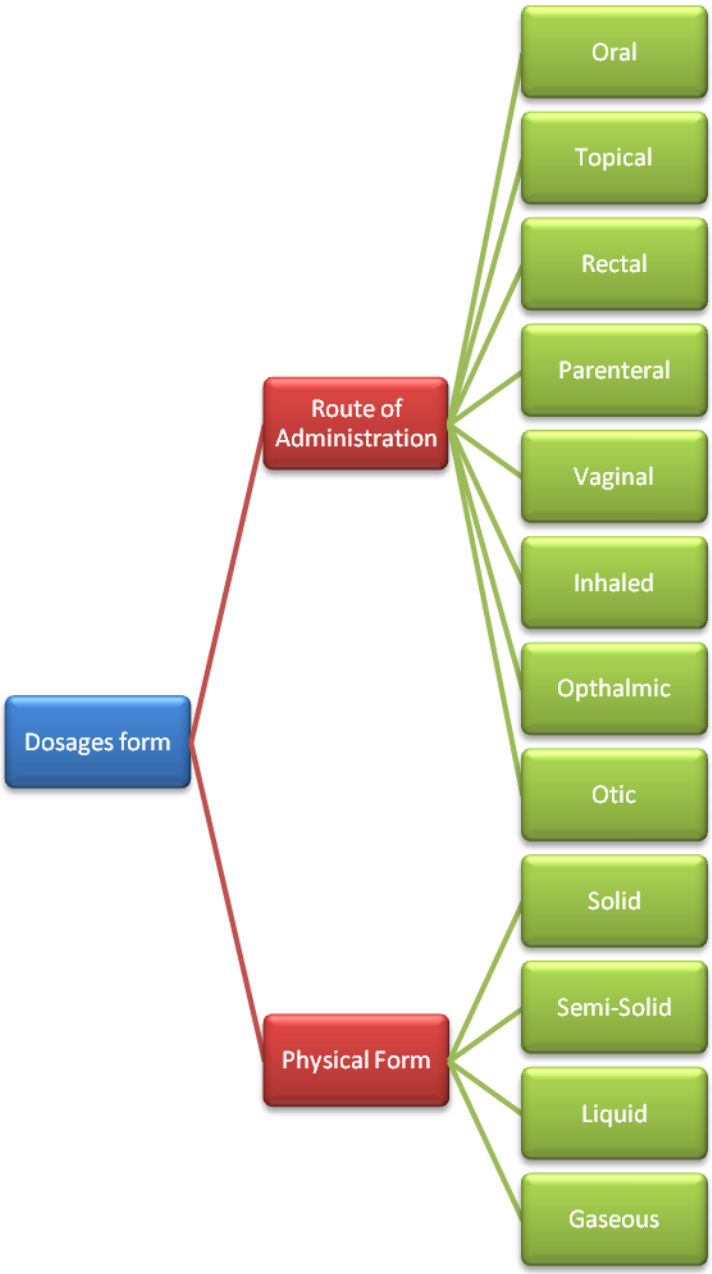


Figure: The figure shown classification of the dosages forms.

Selection of Dosages form:

During the past four decades, the pharmaceutical industry has invested vast amounts of time and money in the study of unit dosage form. This expenditure is quite reasonable when one considers how valuable tablet as dosages form, are to the industry. Because oral dosages forms can be self-administration by the patient, they are obviously more profitable to manufacture than parental dosages forms that must be administered, in most cases, by trained personnel. This is reflected by the fact that well over 80% of the drugs in the India that are formulated to produce systemic effects are marketed as oral dosages forms[(1)].

Unit Dosages forms:

Solid medicaments may be administered orally as **powders**, **pills**, **cachets**, **capsules** or **tablets** .These dosage forms contain a quantity of drug which is given as a single unit and they are known collectively as solid unit dosage forms**,** even in the case of sustained action preparations which, technically, contain the equivalent of several normal doses of drug .The stringent formulation requirements of modern medicaments, the many advantages of tablet and

capsule medication, coupled with expanding health services and the commitment need for large-scale economic manufacture, have led to a steady decline in the prescribing of powders and pills .Tablets and capsules, on the other hand, currently account for well over two third of the total number and cost of medicines produced all over the world[2].

Powders[3]:

A powder is a dry, bulk solid composed of a large number of very fine particles that may flow freely when shaken or tilted.

Pills[4]:

A pill was originally defined as a small, round, solid pharmaceutical oral dosage form of medication that was in use before the advent of tablets and capsules. Pills were made by mixing the active ingredients with an excipient such as glucose syrup in a mortar and pestle to form a paste, then rolling the mass into a long cylindrical shape (called a "pipe"), and dividing it into equal portions, which were then rolled into balls, and often coated with sugar to make them more palatable.

Today, pills include tablets, capsules, and variants thereof like caplets—essentially anything with medication that can be digested, minus the liquid forms, colloquially falls into the pill category.

Some pills are designed to contain sensory and communication elements that collect and wirelessly transmit physiological information after being swallowed. The oldest known pills were made of the zinc carbonates hydrozincite and smithsonite. The pills were used for sore eyes, and were found aboard a Roman ship Relitto del Pozzino which wrecked in 140 BC.

Cachets[5]:

A cachet is an edible container containing dry powdered drugs for oral administration. The shell consists of two concave pieces of wafer made of flour and water.

Tablet:

Tablet is a solid dosage forms each containing a unit dose of one or more medicaments with or without suitable excipients. Tablets may be swallowed whole or being chewed. Some are dissolved or dispersed in water before administration. Some are put in oral cavity, where the active ingredient is liberated at a predetermined rate. Implants or passeries may also be presented in form of tablet.

Tablet may vary in shape and differ greatly in size and weight depending on the amount of medicinal substance and the intended mode of administration[6]. Tablets are usually solid, right circular cylinders, the end surfaces of which are flat or convex and the edges of which may be bevelled. They may exist in other shapes like triangular, rectangular, etc also. They may have lines or break-marks and may bear a symbol or other markings. They are sufficiently hard to withstand handling without crumbling or breaking[7].

Capsule[8]:

Capsule are solid dosage forms in which the drug substance is enclosed within either a hard or soft soluble shell. The shells generally are formed from gelatine. The capsule may be regarded as a “container” drug delivery system that provides a tasteless/orderless dosage form without the need for a secondary coating step, as may be required for tablets. Swallowing is easy for most patients, since the shells is smooth and hydrate in the mouth, and the capsule often tends to float upon swallowing in the liquid taken with it. Their availability in a wide variety of colors makes capsules aesthetically pleasing. There are numerous additional advantages to capsule as a dosage form, depending on the type of capsule employed. Capsule may be classified as either hard or soft depending on the

nature of the shell. Soft gelatin capsules (sometimes referred at as “softgels”) are made form a more flexible, plasticized gelatin film than hard gelatine capsules. Most capsule of either type is intended to be swallowed whole: however, some soft gelatin capsules are intended for rectal or vaginal insertion as suppositories. The majority capsule products manufactured today are of the hard gelatin type.

Tablet (Selected Unit Dosages form):

Compare to other oral dosage forms, tablet are the manufacturer’s dosages form of choice because of their relatively low cost of manufacture, package and shipment: increased stability and virtual tamper resistance (most tampered-with tablets either become discoloured or disintegrate)[(9)].

Tablets are a popular dosage form for oral delivery within the consumer health sector, as well as for ethical prescription products. Over 80% of marketed products are solid-dosage forms. The wide-ranging acceptance of tablet dosage forms probably stems fromthe fact that they are able to simultaneously satisfy biopharmaceutical, marketing, production, and patient requirements.

Biopharmaceutically, tablets can be formulated for immediate or controlled release drug delivery. Additionally, tablets provide for gastric or enteric drug release, and multiple drug substances can be released from a single dosage form. Marketing groups also prefer tablets due to the number of options available for ‘‘branding’’ a product. For example, tablets can be formed in a variety of shapes and sizes, branded with embossing, debossing or printing, supplied in a multitude of colors using internal dyes and/or lakes or externally coated with films containing colorants. Production favors tablets over other dosage forms for their low cost of manufacture, which takes into consideration the cost of the raw materials, and the speed at which tablets can be produced. In the pharmaceutical industry today, tablets can be manufactured at rates of over one million units per hour. Although this rate of output is impressive, compression is still the rate-limiting manufacturing unit operation for many tablet product processes. Finally, patient convenience and preference for tablets drive the market. They are portable, easy to swallow, and have the possibility of masking the taste of the medicine that is being taken.

The ultimate goal of many pharmaceutical formulation strategies is to achieve a marketable tablet dosage form, based on a balance between development cost and the attrition risk for the compound being developed. For new molecular entities destined to be commercial tablets, it is not uncommon for proof of concept studies or early clinical trials to use a powder-in-bottle approach or a hard gelatin capsule dosage form. In these cases, the attrition risk for clinical failure is high and it is not considered economical to develop a tablet early in the program. Specifically, tablets usually require more drug substance to develop, and this generally precludes many pharmaceutical companies from employing tablets in early clinical development. In many cases, a tablet is developed after the compound progresses to late clinical development (phase IIb or III), where the attrition risk is reduced. In these cases, the tablet development is usually coordinated for use in pivotal clinical studies, or linked with the clinical form used in the pivotal studies with a bioequivalency study. In those situations where the attrition risk is low for the compound under development, e.g., product line extensions or generic dosage forms, tablet development may be undertaken at the beginning of development. In order to reduce associated costs, tablet development usually begins at a small scale. Indeed, many tablet products have progressed from a manual, one-at-a-time compaction process (Carver Press) through a single station compaction (e.g., F-Press, EK0), to a small-scale rotary tablet press (e.g., B3B, Betapress) and eventually to compaction on a production scale rotary tablet press (e.g., Fette 3090). It is this progression, from small-scale to large-scale compaction, that is the subject of this chapter. The ultimate test for the scale-up of a tableting process is the establishment of a successful, routine manufacturing process within a production environment. There are many objective criteria associated with commercial manufacture that can be measured and modelled with statistical process control, e.g., weight uniformity, compaction force, content uniformity,

and tablet properties (hardness, thickness, friability, etc.), as well as other, more subjective criteria, e.g., appearance, sticking, picking, capping, lamination, etc., that are just as important but more difficult to model.

Successful scale-up of the tableting process also requires control of the raw materials used in compaction. Typically, pharmaceutical excipients vary in their physicochemical properties, which result in batch-to-batch variations. The tableting process, especially direct compression processes where there is limited raw material alteration before compaction, is susceptible to raw material variation, which may be magnified upon scale-up. Compaction science affords the ability to ''fingerprint'' raw materials, including the drug substance, to determine if the same compaction properties will be observed from batch to batch. This also allows for a rational approach for determining alternate vendor sources of the same materials [(10)].

The Advantages of the Tablet dosages form are[(11)]:

- Tablets are convenient to use and are an elegant dosage form.
- A wide range of tablet types is available, offering a range of drug release rates and durations of clinical effect. Tablets may be formulated to offer rapid drug release or controlled drug release, the latter reducing the number of daily doses required (and in so doing increasing patient compliance).
- Tablets may be formulated to release the therapeutic agent at a particular site within the gastrointestinal tract to reduce side effects, promote absorption at that site and provide a local effect (e.g. ulcerative colitis). This may not be easily achieved by other dosage forms that are administered orally.
- Tablets may be formulated to contain more than one therapeutic agent (even if there is a physical or chemical incompatibility between each active agent). Moreover, the release of each therapeutic agent may be effectively controlled by the tablet formulation and design.
- With the exception of proteins, all classes of therapeutic agents may be administered orally in the form of tablets.
- It is easier to mask the taste of bitter drugs using tablets than for other dosage forms, e.g. liquids.
- Tablets are generally an inexpensive dosage form.
- Tablets may be easily manufactured to show product identification, e.g. exhibiting the required markings on the surface.
- The chemical, physical and microbiological stability of tablet dosage forms is superior to other dosage forms.

Various types of Tablets[(12) (13)]:

Based on the route of administration or the function, the tablets are classified as follows.

(A) Tablets ingested orally:

1. Compressed tablet, e.g. Paracetamol tablet
2. Multiple compressed tablet
   i.Layered Tablet
   ii.Compression coated Tablet
3. Repeat action tablet
4. Delayed release tablet, e.g. Enteric coated Bisacodyl tablet
5. Sugar coated tablet, e.g. Multivitamin tablet
6. Film coated tablet, e.g. Metronidazole tablet
7. Chewable tablet, e.g. Antacid tablet
8. Targeted tablet
   i. Floating tablet
   ii. Colon targeted tablet

These tablets are meant to be swallowed intact along with a sufficient quantity of potable water. Exception is chewable tablet. Over 90% of the tablets manufactured today are ingested orally. This shows that this class of formulation is the most popular world wide and the major attention of the researcher is towards this direction.

(B) Tablets used in oral cavity:

1. Buccal tablet, e.g. Vitamin-c tablet
2. Sublingual tablet, e.g. Vicks Menthol tablet
3. Troches or lozenges
4. Dental cone

The tablets under this group are aimed release API in oral cavity or to provide local action in this region. The tablets under this category avoids first-pass metabolism, decomposition in gastric environment, nauseatic sensations and gives rapid onset of action. The tablets formulated for this region are designed to fit in proper region of oral cavity.

(C) Tablets administered by other route:

1. Implantation tablet
2. Vaginal tablet, e.g. Clotrimazole tablet

These tablets are administered by other route except for the oral cavity and so the drugs are avoided from passing through gastro intestinal tract. These tablets may be inserted into other body cavities or directly placed below the skin to be absorbed into systemic circulation from the site of application.

(D) Tablets used to prepare solution:

1. Effervescent tablet, e.g. Dispirin tablet (Aspirin)
2. Dispensing tablet, e.g. Enzyme tablet (Digiplex)
3. Hypodermic tablet
4. Tablet triturates e.g. Enzyme tablet (Digiplex)

The tablets under this category are required to be dissolved first in water or other solvents before administration or application. This solution may be for ingestion or parenteral application or for topical use depending upon type of medicament used.

Compressed Tablets

Standard uncoated tablets are manufactured by compression. The general methods as - wet granulation, dry granulation or direct compression, are used. These types of tablet produce both type of action, i.e. systemic effect and local effect. Various patents on compressed tablets include the following:

1. Leal (1962) worked on “method of making a compressed tablet”. This invention involves a new process of forming firm, smooth, and pharmaceutically elegant compressed tablets from particulate tableting compositions devoid of a tablet die lubricant[(14)].

2. Stearns (1960) worked on “use of Calcium Silicate in tablet compressing”. In this invention, it is found that the addition of about 20% w/w of calcium silicate aerogel to crystalline or powdered blend so that it become capable to directly compressed into suitable tablets form on automatic tablet punching machine. Lubricants such as magnesium stearate, fillers such as starch, or disintegrate or such as polyvinyl pyrrolidone may be added to the mixture of the calcium silicate aerogel and the crystalline or powdered material prior to tableting on automatic tablet punching

machine. This invention completely eliminates the necessity of first preparing a granulation of crystalline or powdered materials before compressing them into tablets [15].

3. Creevy (1948) worked on “manufacture of the Compressed Tablets”. The main aim of the invention is to overcome the difficulties and provide an improved means for manufacture of compressed tablet. By constructing the wall of the compression chamber in a tableting machine of a suitable porous metal and supplying a liquid lubricant. Under pressure to said porous metal a ‘film of lubricant can readily be formed on the inner wall; of the compression chamber, thus enabling materials which normally tend to bind in the die and to be injectable there from [16].

4. Whyte (1902) worked on Compressed Tablets in which, it is found that if the dry potassium carbonate and ferrous sulfate mixed and compressed into a tablet there will be a reaction soon resulting in the product of ferric carbonate and consequent deterioration of the tablet. On the other hand, by compressing these reagents together in layers, the reaction can only take place along the surface of contact, and have found that the extent of the reaction is so small as not to materially impair the value of the tablet [17].

Multiple compressed tablets:

For incompatible components these are:

A) Layered tablet- either two layered (for two components) or three layered (for three components) tablet.

B) Compressed coated type- either tablet within a tablet or tablet within a tablet within a tablet. Tablet in this category are usually prepared for two reasons

1. To separate physically or chemically incompatible ingredients.
2. To produce repeat action or prolong action product.

Repeat action tablet:

Sugar coated or multiple compressed tablets are used for this purpose .The core tablet is usually coated with shellac or an enteric polymer so that it will not release its drug in stomach but intestine.

Delayed action and enteric-coated tablet:

This dosage form is intended to release the drug after some time delay or after the tablet has passed one part of the GIT into another. All enteric coated tablets are type of delayed action tablet but all delayed action tablets are not enteric or not intended to produce enteric action[2].

Sugar coated tablet:

Primary role is to produce an elegant, glossy, easy to swallow, widely utilized in preparing multivitamin and multivitamin mineral combination. Sugar coating doubled the tablet weight. Now polymers are used with sugar solution.

Film coated tablet:

One type of coated tablet in which drug is not required in coating. This is an attractive method within one or two hours. Polymers such as hydroxypropylcellulose, hydroxypropylmethyl cellulose, and colloidal dispersion of ethylcellulose are commonly used. A 30% dispersion of ethyl cellulose is known as aquacoat. Advantage of film coated over sugar coated tablets is better mechanical strength and flexibility of the coating, little increase in tablet weight.

Chewable tablet:

These are intended to be chewed in the mouth before swallowing. Used for large tablet of antacid, bitter or foul testing drugs are not suitable for this type tablet.

Buccal and sublingual tablet:

These tablets are small, flat and are intended to be held between the cheek and teeth or in cheek pouch (buccal tablet) or below the tongue (sublingual tablet). Drugs used by this route are for quick systematic action. The tablets are designed not to be disintegrated but slowly dissolve.

Troches and lozenges:

Used in the oral cavity to exert local effect in mouth and throat. They are commonly used to treat sore throat or to control coughing in common cold. They may contain local anesthetics, antiseptic, antibacterial agents, demulcents, astringent and antitussive. The tablets are dissolving slowly over a period of 30 minutes.

Dental cone:

These tablets are designed to be placed in the empty socket remaining after tooth extraction. Main purpose is to prevent microbial growth in the socket or to reduce bleeding.

Implantation tablets:

Designed for substances implantation to provide prolonged drug effect from one month to a year, tablets are usually small, cylindrical not more than 8mm length. These methods require special surgical technique for implantation and discontinuation of therapy. Generally used for administration of growth hormone to food producing animal.

Vaginal tablets:

These are designed to undergo slow dissolution and drug release in vaginal cavity. Tablets are wide or pear shaped, used to antibacterial, antiseptic and astringent to treat vaginal infection[18].

Effervescent tablets:

Tablets are designed to produce a solution rapidly with the release of carbon dioxide. The tablets are prepared by compressing the active ingredient with mixture of organic acid such as citric acid or tartaric acid and sodium bicarbonate.

Dispersing tablets:

Tablets are intended to be added to a given volume of water to produce a solution of a given drug concentration.

Hypodermic tablets:

These tablets are composed of one or more drugs with water-soluble ingredients. Drug is added to sterile water to prepare sterile solution, which is injectable.

Tablet triturates:

Usually are made from moist materials using a triturate mold, which gives them the shape of cylinder. Such tablet must be completely and rapidly soluble[19].

Ingredients Used in Tablets:

In addition to active ingredients, tablet contains a number of inert materials known as additives or excipients. Different excipients are:

1. Diluent
2. Binder and adhesive
3. Disintegrents
4. Lubricants and glidants
5. Colouring agents
6. Flavoring agents
7. Sweetening agents

1. Diluent[20]:

Diluents are fillers used to make required bulk of the tablet when the drug dosage itself is inadequate to produce the bulk. Secondary reason is to provide better tablet properties such as improve cohesion, to permit use of direct compression manufacturing or to promote flow. A diluent should have following properties:

a) They must be nontoxic and acceptable to the regulatory agencies in all countries where the product is to be marketed.
b) They must be commercially available in an acceptable grade in all countries where the product is to be manufactured.
c) Their cost must be acceptably low.
d) They must not be contraindicated by themselves (e.g., sucrose) or because of a compound (e.g., sodium) in any segment of population.
e) They must be physiologically inert.
f) They must be physically and chemically stable by themselves and in combination with the drug and other tablet components.
g) They must be free of any unacceptable microbiologic “load”.
h) They must be color-compatible (not produce any off-color appearance).
i) If the drug product is also classified as a food, (certain vitamin products), the diluent and other excipients must be approved direct food additives.
j) They must have no deleterious effect on the bioavailability of the drugs in the product.

Examples of Diluents in Tablets[21]:

1) Lactose-anhydrous and spray dried lactose
2) Directly compressed starch-Sta Rx 1500
3) Hydrolyzed starch-Emdex and Celutab
4) Microcrystalline cellulose-Avicel (PH 101and PH 102)
5) Dibasic calcium phosphate dehydrate
6) Calcium sulphate dihydrate
7) Mannitol
8) Sorbitol
9) Sucrose- Sugartab, DiPac, Nutab
10) Dextrose

Lactose:

Most widely used diluent in tablet formulation. Lactose has no reaction with most drugs, whether it is used in hydrous or anhydrous form. Anhydrous lactose has advantage over lactose that it does not undergo Maillard reaction which is browning & discoloration of tablet due to the interaction of amine drug with lactose. Spray dried lactose in conc 20-25% of active ingredient is used for direct compression.

Starch obtained from corn, wheat, potatoes is used as diluent, Sta-Rx 1500 is free flowing, direct compressible starch used as diluent, binder and /or disintegrating agent. Two hydrolyzed starch Emdex and Celutab, which are combination of 90-92% of dextrose and 3-5% of maltose, are free flowing and direct compressible.

Sucrose is used as diluent. Some sugar-based diluents are used for direct compression. These are:

a) Sugartab: 90-93% sucrose and 7-10% invert sugar
b) DiPac: 97%sucrose and 3% modified dextrin
c) Nu Tab: 95%sucrose & 4% invert sugar with small amount of corn starch & magnesium stearate.

Microcrystalline cellulose, having trade name Avicel is used for direct compression. These are two types: PH101 (Powder) and PH102 (Granules). Dibasic calcium phosphate and calcium sulphate used as diluents but reduce bioavailability of tetracycline tablet.

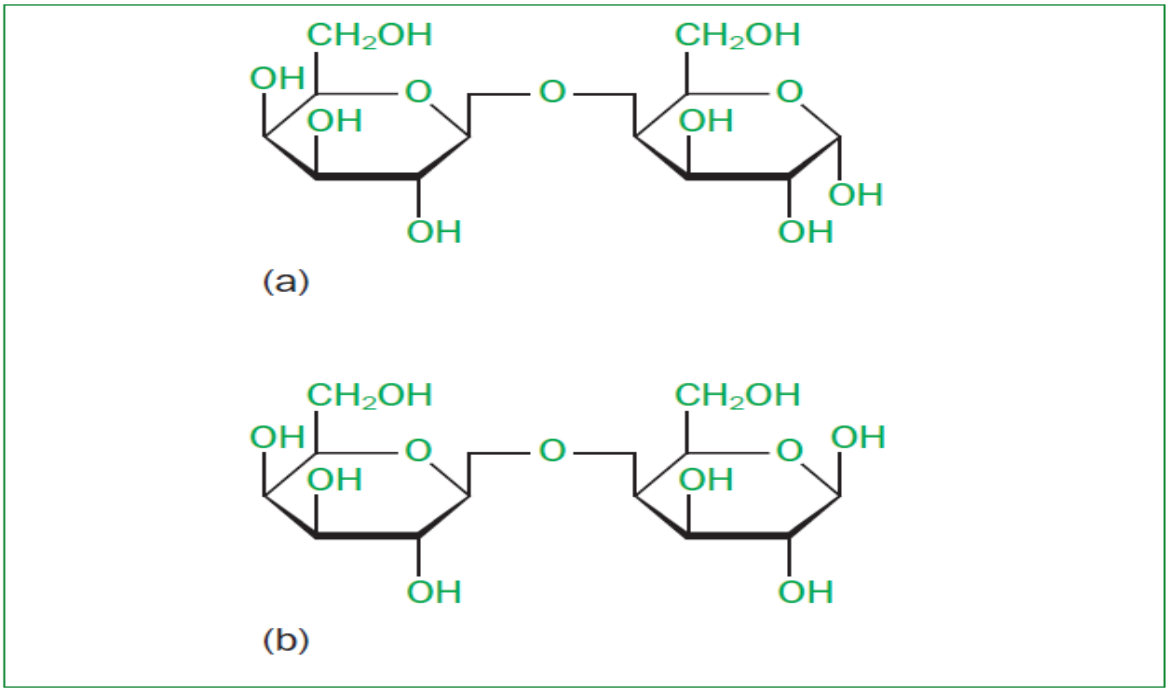


Figure: Structural Formulae of: (a) anhydrous α-lactose and (b) anhydrous β-lactose.

2. Binders and Adhesives[22]:

These materials are added either dry or in wet- form to form granules or to form cohesive compacts for directly compressed tablet.

Examples of Binders in Tablets:

1) Acacia, tragacanth- Solution for 10-25% Conc.
2) Cellulose derivatives- Methyl cellulose, Hydroxy propyl methyl
3) cellulose, Hydroxy propyl cellulose
4) Gelatin- 10-20% solution
5) Glucose- 50% solution
6) Polyvinylpyrrolidone (PVP)- 2% conc.
7) Starch paste-10-20% solution
8) Sodium alginate
9) Sorbitol

3. Disintegrants:

Disintegrants are employed in tablet formulations to facilitate the breakdown of the tablet into granules upon entry into the stomach. If the formulated tablet is hydrophobic and/or it has been manufactured using a high compression force, the rate of water uptake into, and hence disintegration of, the tablet will be unacceptably low. In these situations disintegrants are an essential formulation component, enabling tablet disintegration to occur within the specifications defined in the various pharmacopoeias (typically disintegration of conventional tablets must occur within 15 minutes).

Examples of Disintegrants in Tablets:

1) Starch- 5-20% of tablet weight.
2) Starch derivative – Primogel and Explotab (1-8%)
3) Clays- Veegum HV, bentonite 10% level in colored tablet only Cellulose
4) Cellulose derivatives- Ac- Di-Sol (sodium carboxy methyl cellulose)
5) Alginate
6) PVP (Polyvinylpyrrolidone), cross-linked

Superdisintegrants:

Swells up to ten fold within 30 seconds when contact water. A portion of disintegrant is added before granulation and a portion before compression, which serve as glidants or lubricant. Evaluation of carbon dioxide in effervescent tablets is also one way of disintegration.

Various Superdisintegrants and Their Properties[23]:

Superdisintegrants	Commercially available Grades	Mechanism of action	Comment
Crosslinked cellulose	Crosscarmellose® Ac-Di-Sol®, Nymce ZSX® Primellose®, Solutab®, Vivasol®, L-HPC.	Swells 4-8 folds in < 10 seconds. Swelling and wicking both.	Swells in two dimensions. Direct compression or Granulation Starch free.
Crosslinked PVP	Crosspovidon M® Kollidon® Polyplasdone®	Swells very little and returns to original size after compression but act by capillary action.	Water insoluble and spongy in nature so get porous tablet.

Crosslinked starch	Explotab® Primogel®	Swells 7-12 folds in < 30 seconds.	Swells in three dimensions and high level serve as sustain release matrix.
Crosslinked alginic Acid	Alginic acid NF	Rapid swelling in aqueous medium or wicking action.	Promote disintegration in both dry or wet granulation.
Soy polysaccharides	Emcosoy®		Does not contain any starch or Sugar. Used in nutritional products.
Calcium silicate		Wicking action.	Highly porous, Light weight,

4. Lubricant and Glidants[24]:

Tablet lubricants are those crucial components of oral solid dosage form which prevents adhering of granules to die wall. Lubricants also helps tablet to get rid of various defects like lamination,sticking,chipping. Mode of action of lubricants follows different ways. Lubricants creates a film layer in between die wall and granules.When the lubricant is thought to offer a lower shear interface than that characteristic of the die wall tablet surfaces and will thus readily shear when tangential motion is initiated between the tablet and die during the ejection process. Lubricants are intended to prevent adhesion of the tablet materials to the surface of dies and punches, reduce inter particle friction and may improve the rate of flow of the tablet granulation. Glidants are intended to promote flow of granules or powder material by reducing the friction between the particles.

Examples of Lubricant in Tablets:

1) Stearic acid
2) Magnesium stearate
3) Talc
4) PEG (Polyethylene glycols)
5) Surfactants

Examples of Glidants in Tablets:

1) Corn Starch – 5-10% conc.
2) Talc-5% conc.
3) Silica derivative - Colloidal silicas such as Cab-O-Sil,
4) Syloid
5) Aerosil in 0.25-3% conc.

5. Coloring Agent:

The use of colors and dyes in a tablet has three purposes:

(1) Masking of off color drugs
(2) Product Identification
(3) Production of more elegant product

All coloring agents must be approved and certified by FDA. Two forms of colors are used in tablet preparation – FD &C and D & C dyes. These dyes are applied as solution in the granulating agent or Lake form of these dyes. Lakes are dyes absorbed on hydrous oxide and employed as dry powder coloring.

Examples of Coloring Agent in Tablets:

1) FD & C yellow 6-sunset yellow
2) FD & C yellow 5- Tartrazine
3) FD & C green 3- Fast Green
4) FD & C blue 1- Brilliant Blue
5) FD & C blue 2 - Indigo carmine
6) D & C red 3- Erythrosine.
7) D & C red 22 – Eosin Y

6. Flavouring Agent:

Flavours are usually limited to chewable tablets or other tablets intended to dissolve in the mouth. In general, flavours that are water soluble have found little acceptance in tablet making because of their poor stability. Flavour oils are added to tablet granulation in solvents, are dispersed on clays and other absorbents or are emulsified in aqueous granulation agents. Various dry flavours for use in pharmaceutical product are also available from flavour suppliers. Usually, the maximum amount of oil that can be added to a granulation without influencing its tabletting characteristic is 0.5 to 0.75%.

7. Sweetening Agents[25]:

Sweetening agents are employed in liquid formulations designed for oral administration specifically to increase the palatability of the therapeutic agent. The main sweetening agents employed in oral preparations are sucrose, liquid glucose, glycerol, sorbitol, saccharin sodium and aspartame. The use of artificial sweetening agents in formulations is increasing and, in many formulations, saccharin sodium is used either as the sole sweetening agent or in combination with sugars or sorbitol to reduce the sugar concentration in the formulation. The use of sugars in oral formulations for children and patients with diabetes mellitus is to be avoided.

Relative Sweeteness of commonly used Sweeteners[26]

Sweetening agents	Relative Sweeteness*	Comment
Aspartame	200	Not very stable in solution
Acesulfame Potassium	137-200	Bitter after taste if used in higher concentration
Cyclamate	40	Banned
Glycerrhizin	50	Moderately expensive
Lactose	0.16	Large amount required
Manitol	0.60	Negative heat of solution
Saccharin	450	Unpleasent after taste
Sucrose	1	Most commonly used
Sucralose	600	Synergestic sweetening effect

*Sucrose is taken as a standard of 1 for comparison.

Various Types of Tablet Manufacturing Methods[27]:

1. Direct Compression
2. Dry granulation
3. Wet Granulation

Steps Involved in Tablet Manufacturing [28]

Processing Step	Wet	Dry	Direct
Raw Material	✓	✓	✓
Weigh	✓	✓	✓
Screen	✓	✓	✓
Mix	✓	✓	×
Compress (Slug)	×	✓	×
Wet Mass	✓	×	×
Mill	✓	×	×
Dry	✓	×	×
Mill	✓	✓	×
Mix	✓	✓	×
Compress	✓	✓	✓

1. Direct Compression:

Direct compression is the simplest and most economical method for the manufacturing of tablets because it requires less process in than other techniques. Introduction of spray dried lactose (1960) and Avicel (1964) had changed the tablet manufacturing process and opened avenues of direct compression tableting[29]. The term direct compression is used to define the process by which tablets are compressed directly from powder blends of active ingredient and excipients, which flow uniformly in the dies & forms a film compact[30].

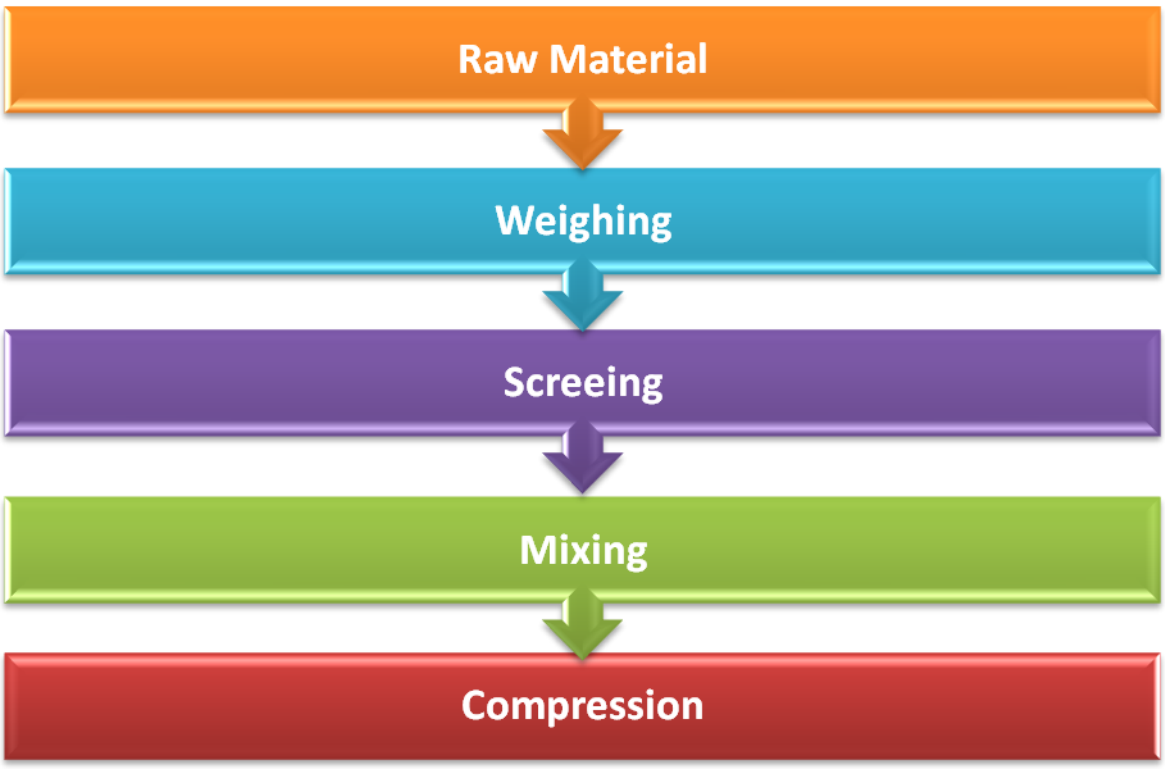
Direct compression consists of compressing tablets directly from powdered material without modifying physical nature of materials. This method is applicable for crystalline chemicals having good compressible characteristic and flow properties such as: Potassium salt (chlorate, chloride, bromide), sodium chloride, Ammonium chloride, methenamine etc.

Compressed tablets are prepared by single compression using tablet machines. After a quantity of powdered or granulated tabletting material flow into die, the upper and lower punches of the tablet punching machine compress the material under a high pressure.

Direct compression is a popular choice because it provides the shortest, most effective and least complex way to produce tablets. The manufacturer can blend an Active pharmaceutical ingredient with the excipient and lubricant, followed by compression, which makes the product easy to process. No additional processing steps are required.

Moisture or heat sensitive ingredients, which would be contraindicated in wet granulation, can also be used in this types of process. However, it does require a very critical selection of excipients in comparison to granulation processes because the raw materials must demonstrate good flowability and compressibility for successful operation[31].

The Processing steps involved in direct compression[32]



Commonly Used Excipients in direct compression formulation[33]

Function	Common Examples
Diluent	Lactose Monohydrate, Anhydrous Lactose, Mannitol
Super-Disintegrant	Croscarmellose Sodium, Crospovidine, Sodium Starch Glycolate
Lubricant	Stearic Acid, Calcium Stearate, Magnesium Stearate
Glidant	Colloidal Silicon, Dioxide, Talc
Pigment	Aluminium lakes, Iron Oxides
Stabiliser	Buffer Such as sodium carbonate and citric acid
Surfactant	Sodium Lauryl Sulphate

Advantages of Direct Compression[34]:

1. **Cost Effectiveness:**

The prime advantage of direct compression over wet granulation is economic since the direct compression requires fewer unit operations. This means less equipment, lower power consumption, less space, less time and less labour leading to reduced production cost of tablets.

2. Stability:

Direct compression is more suitable for moisture and heat sensitive APIs, since it eliminates wetting and drying steps and increases the stability of active ingredients. Changes in Dissolution profiles are less likely to occur in tablets made by direct compression on storage than in those made from granulations.

3. Faster Dissolution:

Disintegration or dissolution is the rate limiting step in absorption in case of tablets with poorly soluble API prepared by wet granulation. The tablets prepared by direct compression disintegrate into API particles instead of granules that directly come into contact with dissolution fluid and exhibits comparatively faster dissolution.

4. Less wears & tears of punches:

The high compaction pressure involved in the production of tablets by slugging or roller compaction can be avoided by adopting direct compression. The chances of wear and tear of punches and dies are less.

5. Other advantages:

As ingredients are processed for a shorter period of time, the chance for contamination is low. Due to fewer unit operations, the validation and documentation requirements are reduced and will become easier. Due to the absence of water in granulation, chance of microbial growth is minimal in case of tablets prepared by direct compression.

Limitation of Direct Compression[(34)]:

1. Segregation:

Direct compression is more prone to segregation due to the difference in density of the active pharmaceutical ingredient and excipients. The dry state of the materials during mixing may induce static charges and lead to segregation. This may lead to the problems like weight variation and content nonuniformity.

2. Cost:

Directly compressible excipients are the speciality products produced by spray drying, fluid bed drying, roller drying or co-crystallization. Hence, the products are relatively costly than the respective raw materials.

3. Low dilution potential:

Most of the directly compressible materials can accommodate only 30-40 % of the poorly compressible active ingredients like acetaminophen that means the weight of the final tablet to deliver the 500 mg of acetaminophen would be more than 1300 mg. The large tablets may create difficulty in swallowing.

4. Lubricant sensitivity:

Lubricants have more adverse effect on the filler, which exhibit almost no fracture or shear on compression (e.g. starch 1500). The softening effects as well as the hydrophobic effect of alkaline stearates can be controlled by optimising the length of blending time to as little as 2-5 min.

5. Variation in functionality:

There is a lack of awareness in some situations that the excipient behave differently, depending upon the manufacturer so much so that substitution from one source to that of another is not possible. Hence, there is a need for greater quality control in purchasing of raw materials to assure batch uniformity.

2. Dry Granulation:

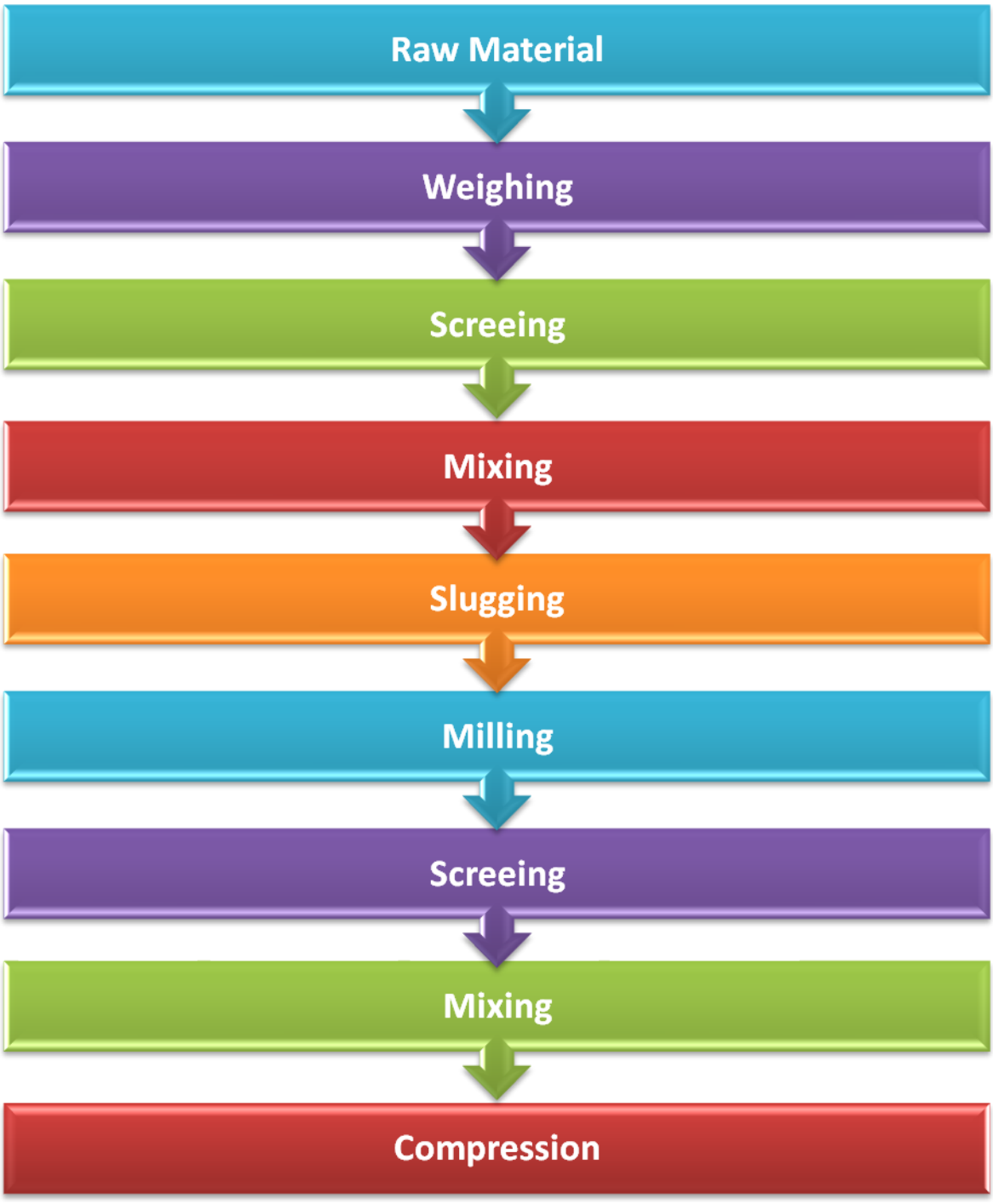
Dry granulation or compression granulation has been used for many years, and is a valuable technique in situations where the effective dose of a drug is too high for direct compaction, and the drug is sensitive to heat, moisture, or both, which precludes wet granulation. Many asprin and vitamin formulation are prepared for tabletting by dry granulation.

Current usage of the term “direct compression” is used to define the process by which tablets are compressed directly from the powder blends of active ingredient/s and suitable excipients. No pre-treatment of the powder blends by wet or dry granulation is involved[(35)]. The simplicity of the direct compression process is apparent from a comparison of the steps involved in the manufacture of tablets by wet granulation, roller compaction and direct compression techniques. It has been estimated that less than 20 percent of pharmaceutical materials can be compressed directly into tablets[(36)]. The rest of the materials lack flow, cohesion or lubricating properties necessary for the production of tablets by direct compression. The use of directly compressible adjuvant may yield satisfactory tablets for such materials.

Directly compressible adjuvants

The International Pharmaceutical Excipients Council (IPEC) defines excipient as “Substances, other than the active pharmaceutical ingredient in finished dosage form, which have been appropriately evaluated for safety and are included in a drug delivery system to either aid the processing or to aid manufacture, protect, support, enhance stability, bioavailability or patient acceptability, assist in product identification, or enhance any other attributes of the overall safety and effectiveness of the drug delivery system during storage or use”[(37)]. Solvents used for the production of a dosage form but not contained in the final product are considered to be excipients, i.e. the granulation fluids, which might be dried off later, should comply with relevant requirements of pharmacopoeia unless adequately justified [(37)]. Excipients no longer maintain the initial concept of “inactive support” because of the influence they have both over biopharmaceutical aspects and technological factors. The desired activity, the excipients equivalent of the active ingredient’s efficacy, is called its Functionality[(37)]. The inherent property of an excipient is its functionality in the dosage form. Determination of an excipient’s functionality is important to the excipient manufacturer in its assessment of the proper level of GMP, and yet the drug manufacturer may withhold this information until well into the development process[(38)].

The Processing steps involved in Dry Granulation[32]



Advantages of Dry Granulation[39]:

- Both roller compaction and slugging require conventional (i.e.non-specialist) grades of excipients.
- These methods are not generally associated with alterations in drug morphology during processing.
- No heat or solvents are required.

Limitation of Dry Granulation[40]:

- Specialist equipment is required for granulation by roller compaction.
- Segregation of components may occur postmixing.

- There may be issues regarding powder flow.
- The final tablets produced by dry granulation tend to be softer than those produced by wet granulation, rendering them more difficult to process using post-tableting techniques, e.g. film coating.
- Slugging and roller compaction lead to the generation of considerable dust. Therefore, containment measures are required. Furthermore, there may be a reduction in the yield of tablets.

3. Wet Granulation:

Wet granulation is the most widely used process of granulation in the pharmaceutical industry. It involves addition of a liquid solution (with or without binder) to powders, to form a wet mass or it forms granules by adding the powder together with an adhesive, instead of by compaction[41]. The wet mass is dried and then sized to obtained granules. The liquid added binds the moist powder particles by a combination of capillary and viscous forces in the wet state. More permanent bonds are formed during subsequent drying which leads to the formation of agglomerates.

The active ingredient, diluent and disintegrents are mixed or blended well. For large-scale production twin shell blender, double cone blender, planatory mixer, sigma blade mixer, ribbon mixer etc. are commonly used. Solutions of the binding agent are added to the mixed powder with stirring. The powder mass is wetted with the binding solution until the mass has the consistency of damp snow. If the granulation is over wetted the granules will be hard, if not wetted sufficiently, the resulting granules will be too soft, breaking down during lubrication. The wet mass is forced through a 6 or 8 mesh (Mesh no. is the number of wires passing through an inch) screen or several mills can be used .Moist materials from wet milling steps is placed on large trays and placed in drying chambers with a circulating air current and thermostable heat controller. Commonly used dryers are tray dryer, fluidized bed dryer. After drying, the granulation is reduced in particle size by passing smaller mesh screen. After drying granulation, the lubricant or glidants is added as fine powder to promote flow of granules. These granules then compressed to get tablet[42].

Types of Wet Granulation[43]:

Wet granulation can be divided into three main processes of low shear, high shear, and fluid bed granulation. Additionally there is a drive towards continuous wet granulation for improvement in manufacturing efficiency. Each process has its own pros and cons which may be useful for different formulations, but in practise a formulator may not have the choice of which process to use for a particular product, the selection being determined by equipment availability and company preference. Figure shows the typical process for low and high shear granulation with examples of the different types of equipment used.

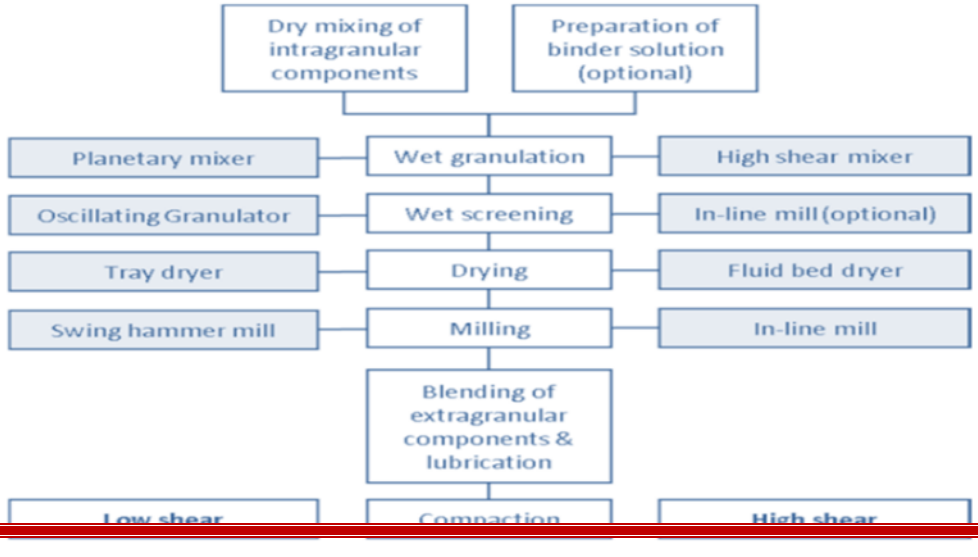
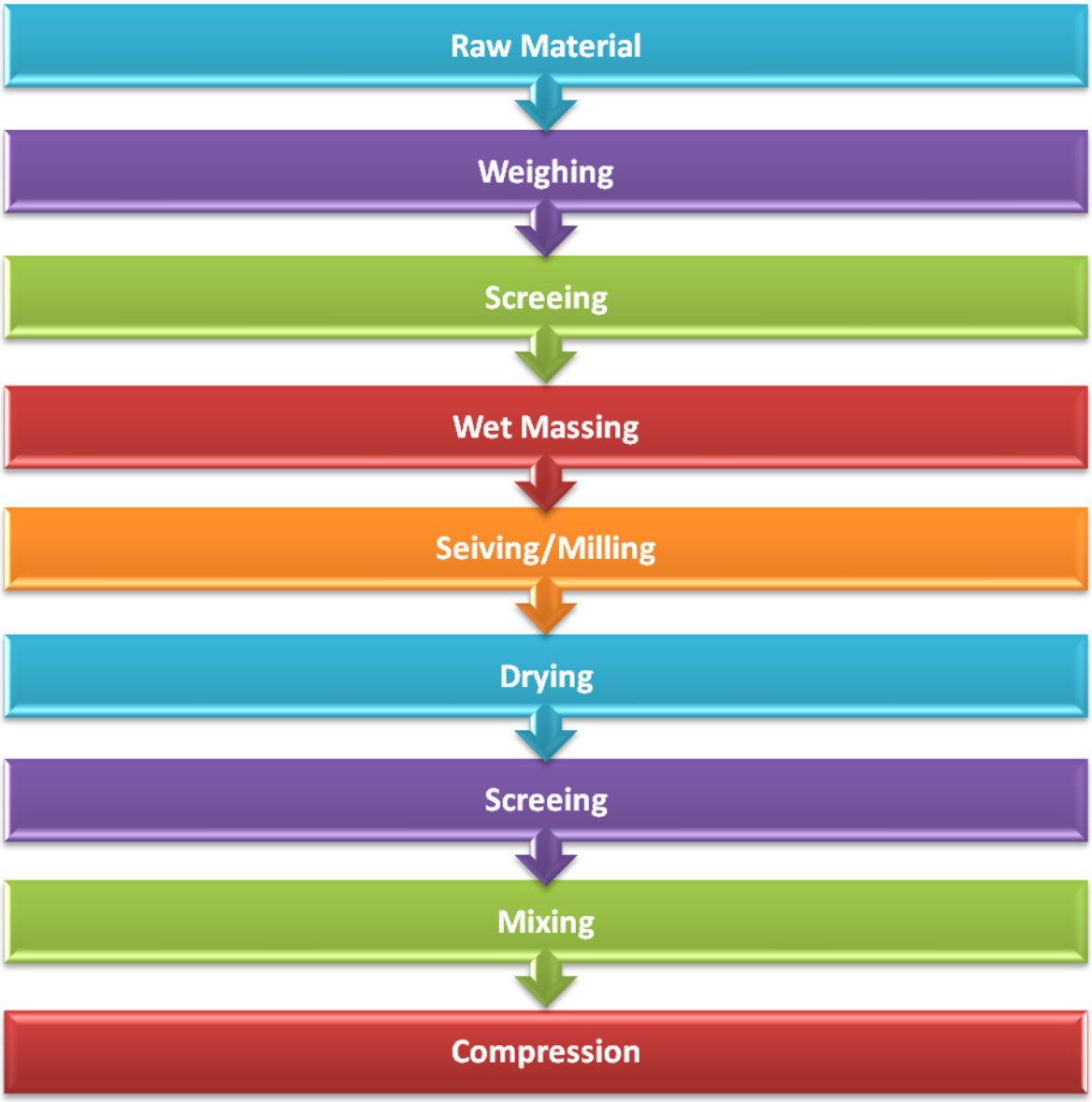


Figure: Schematic of Wet granulation by low shear and high shear processing

The Processing steps involved in Wet Granulation[32]



Commonly Used Excipients in wet granulation[43]

Function	Excipient
Diluent	Microcrystallines Cellulose, Mannitol, Sorbitol, Dextrose
Binder	Povidone, Hypromellose, Hydroxypropyl Cellulose
Disintegrant	Sodium Starch Glycolate, Crospovidone
Lubricant	Talc, Stearic Acid
Glidant	Colloidal Sillicon Dioxide

Advantages of Wet Granulation[44]:

1. Improves flowability and compressibility of the material[45]
2. Bioavailability improves as hydrophobic surfaces gets changed into hydrophilic surfaces.

3. Fast method to prepare controlled release Granules[46].
4. Improves homogeneity of dosage forms with low active content.
5. Adverse influence of poor electrostatic properties of powder can be avoided[45]

Limitation of Wet Granulation[47] [48]:

1. An expensive process associated with requirement for more labour, space, time, special equipment and energy.
2. Involves multiple processing steps thereby increases complexity.
3. Process loss of material was high.
4. Unsuitable for moisture sensitive, thermolabile, and incompatible materials.
5. Any incompatibility between the formulation components was aggravated during the processing.

Tablet Processing Problems[49]

1. Capping & Lamination:

Complete or partial loss of top and bottom crowns of a tablet from the main body is called *capping.* The separation of a tablet into two or more distinct layers is called *lamination.* These problems occur immediately after compression, however may occur after several hours or days.

Cause:

1. Air entrapment
2. Deep concave punch
3. Claw formation of Punch
4. Wear ring formation in die wall
5. Incorrect setting of the press
6. Compression of too dry material

Remedy:

1. By precompression
2. Slowing tableting
3. Reducing final compression force
4. Using flat punch
5. Using hygroscopic materials to maintain proper moisture level eg. - PEG-4000 and Methyl Cellulose

2. Picking & Sticking:

Surface materials from a tablet that is sticking to the punch and being removed from the tablet surface is *picking.* Sticking refers to tablet materials adhering to the die wall. When sticking occurs, additional force is required to overcome the friction between the tablet and die wall during ejection.

Cause:

1. Picking occurs when punch tips are engraving or embossing.

3. Mottling:

It is an unequal distribution of colors on a tablet with light and dark areas on tablet surface.

Cause:

1. Use of a drug whose color differs from tablet excipients
2. Use of a drug whose dehydration products are colored

Remedy:

1. The use of colorant may solve the problem but can create another Problem. A dye can cause mottling by migration to the surface of a Granulation during drying to overcome this difficulty. Change the Solvent system, reduce drying temperature.
2. Disperse a dry color additive during powder binding steps.

4. Weight Variation:

Variation of tablet weight also causes variation of active medicament which change the bioavailability.

Cause:

(a) Granule size & size distribution:

Variations in the ration of small to large granules and difference in granule size determine how the void spaces between particles are filled. Since volume of die cavity remain same, different proportions of large and small particles may change the weight of fill in each die.

(b) Poor Flow:

The die fill process in based on a continuous and uniform flow of granules from the hopper through the feed frame. When the granulation does not flow uniformly some dies are incompletely filled. Dies are also not filled properly when machine speed is in excess of granulations flow capability. With poor flow the addition of a glidant such as talcum or colloidal silica may be helpful.

Depending on the geometry of the hopper, poor flow give rise to another problems like arching or bridging & rat holling

(1) Arching or Bridging:

Granules separate at the neck of the hopper and flow stops completely. Addition of glidant to prevent flow can overcome the problem.

(2) Rat Holling:

In this case particles segregate near the wall of the hopper and at the center flow continues forming hole. In rat holling flow rate decreases which can overcome by using glidant.

(c) Punch Variation:

When length of lower punches is unequal, the fill in each die varies which causes weight variations of tablet.

(d) Poor Mixing:

Some times lubricants and glidants are not thoroughly distributed. The flow of particles then impaired and the granules do not move efficiently into the dies.

5. Hardness Variation:

Hardness depends on the weight of materials and space between upper and lower punch at the moment of compression. If the volume of materials and distance between the punches varies hardness also alters.

6. Double Impression:

This involves only punches that have monogram or engraving. If the monogram present in upper punch, slight rotation of punch after precompression produce double impression. If monogram present in lower punch after

compression is over lower punch move slightly downward to free the tablet and produce double impression. This problem can overcome using non-rotating cam track.

Acknowledgements

The author would like to thank all his mentors. The notes compiled here are collected over a period of time and may have been reproduced verbatim. Apologize to all researchers if in-advertently failed to acknowledge them in the references.

References

1. Kottke MK and Edward M. Rudnic, “Tablet Dosage forms” Morden Pharmaceutics, Fourth Edition, Revised & Expended, New York: 2002.
2. Sahoo PK “Pharmaceutical Technology” Tablets, 1-2, India: 2007, retrieved December 20, 2014 form www.google.com.
3. Definition of “powder” retrieved December 22, 2014 from Wikipedia.com website: http://en.wikipedia.org/wiki/Powder_(substance).
4. Definition of “pill” retrieved December 22, 2014 from Wikipedia.com website: http://en.wikipedia.org/wiki/Pill_(pharmacy).
5. Definition of “cachet” retrived December 22, 2014 form Cancerterms.net website: http://www.cancerterms.net/define-Cachet+Dosage+Form/.
6. W.C. Gunsel, “Compression-Coated and Layer Tablets,” in Pharmaceutical Dosage Forms: Tablets, Volume 1, H. A. Lieberman and L. Lachman, Eds. 187-224, Marcel Dekker, New York: 1980.
7. Indian Pharmacopeia, Vol.2, 45-47, Indian Pharmacopeia Commission 2007.
8. Larry L. Augsburger, “Hard and Soft Shell Capsule” Morden Pharmaceutics, Fourth Edition, Revised & Expended, New York: 2002.
9. Kottke MK and Edward M. Rudnic, “Tablet Dosage forms” Morden Pharmaceutics, Fourth Edition, Revised & Expended, New York: 2002.
10. Royce A, Ruegger C, Mecadon M, Karnachi A, and Valazza S, “Scale-up of the compaction and tableting Process”, P’ceutical Process Scale up, IInd Edition. 371-408 (2006).
11. David Jones, “Pharmaceutics- Dosages form and Design” London: RPS Publishing 2008.
12. Lachman, L., Liberman, H.A., and Kanig. JL Theory and Practice of Industrial Pharmacy, Vargese Publication House,3rd Edition. 1990; pp 329-335.
13. Richa Sood et al. “Immediate Release Antihypertensive Valsartan oral tablet: A review, Jour. of Sci. Res. in Phar. 2012, 1(2), 20-26.
14. Leal BJ. inventor. Leslie Salt Company; assignee. Method of making a compressed tablet. US Patent: US 3,042,531. 1962 Jul 3.

15. Louis SC. inventor. American Cyanamid Company; assignee. Use of calcium silicate in tablet compressing. US Patent: US 2,951,791. 1960 Sept 6.

16. Creevy C. Inventor. Glaxo Laboratories Limited; assignee. Manufacture of compressed tablets and the like from finely divided ingredients. US Patent. US. 2,444,282. 1948 Jun 29.

17. Whyte RM. Inventor. Schieffelin and Company; assignee. Compressed tablet. US Patent, US. 701,438.1902 Jun 3.

18. "Vaginal Tablet" retrieved December 25, 2014 from Google.com, website: nsdli.niscair.res.in.

19. Lachman L, Liberman HA, Kanig JL. The theory and practice of industrial pharmacy. 3rd ed. Philadelphia: lea and febiger; 1986.

20. Lachman, L., Liberman, H.A., and Kanig. JL. Theory and Practice of Industrial Pharmacy, Vargese Publication House, 3rd Edition. 1990; pp 325.

21. David Jones, "Solid-Dosages forms 1: Tablet", Chapter-9, "Pharmaceutics- Dosages form and Design" London: RPS Publishing 2008: pp 210.

22. Lachman, L., Liberman, H.A., and Kanig. JL. Theory and Practice of Industrial Pharmacy, Vargese Publication House, 3rd Edition. 1990; pp 327.

23. Mohanchandra PS et al. "Superdisintegrants: An Overview", Int. Jou. of Pharm. Sci. Review & Research, 2011, 6 (1), 105-109.

24. Bhavdip Faldu et al., "Lubricant: Fundamentals of tablet manufacturing" international journa of research in pharmacy and chemistry, 2012, 2 (4), 921-925.

25. David Jones, "Pharmaceutical Solution for oral administration", Chapter-1, "Pharmaceutics- Dosages form and Design" London: RPS Publishing 2008: pp 1-23.

26. Shalini Sharma et al., " Taste Masking technologies: A Review" International journal of pharmacy & pharmaceutical sciences, 2010, 2 (2), 6-13.

27. Pranjal kumar Singh et al. "Recent advances in direct compression technique for pharmaceutical tablet formulation" International journal of Pharmaceutical research and development, 2014 6 (1), 49-57

28. Liberman et al. "Theory and Practice of Industrial Pharmacy", Vargese Publication House, 3rd Edition. 1990; pp 318.

29. Dokala GK, Pallavi C. Direct Compression – An Overview. International Journal of Research in Pharmaceutical and Biomedical Sciences, 2013, 4 (1), 155-158.

30. McCormick Douglas. Special Report on Evolutions in Direct Compression. Pharmaceutical Technology, www.Pharmtech.Com. April 2005; 52-62.

31. Meeus, L, “Direct Compression Versus Granulation”, Pharmaceutical Technology Europe” 2011, 23 (3).

32. Kaur Harbir “Processing Technologies for Pharmaceutical Tablets: A Review” International Research Journal of Pharmacy, 2012, 3 (7), 20-23.

33. Introduction to tableting by direct compression, DFE Pharma, www.dfepharma.com, 1-11.

34. Gowtham Kumar et al. “Direct Compression- An Pverview”, International Journal of Research in Pharmaceutical and biomedical sciences, 2013, 4 (1), 155-158.

35. Shangraw, R. F., Direct Compression Tableting, Encyclopedia of Pharmaceutical Technology, Vol-4, Marcel Dekker, USA, 2nd ed., 85-160, 1988.

36. Shangraw, R. F., Compressed Tablets by Direct Compression Granulation Pharmaceutical Dosage Forms: Tablets, Vol-1, Marcel Dekker, USA, 2nd edition, 195-246,1989.

37. Robertson, M. I., Regulatory Issues with Excipients, Int. J. Pharm., 187: 273-276, 1999.

38. Silverstein, I., Excipient GMP Quality Standards One is Enough, Pharm. Technol., 25: 46-52, 2002.

39. David Jones, “Solid-Dosages forms 1: Tablet”, Chapter-9, “Pharmaceutics- Dosages form and Design” London: RPS Publishing 2008: pp 231.

40. David Jones, “Solid-Dosages forms 1: Tablet”, Chapter-9, “Pharmaceutics- Dosages form and Design” London: RPS Publishing 2008: pp 232.

41. Leon Lachman, Herbert A. Liberman, Joseph L. Kanig, ”Tablets”, The Theory and Practice of Industrial Pharmacy, 3rd edition, Varghese publishing house, Bombay, 1991: 320-321.

42. Sahoo PK “Pharmaceutical Technology” Tablets,pp10, India: 2007, retrieved December 29, 2014 form www.google.com.

43. Introduction to tableting by wet granulation, DFE Pharma, www.dfepharma.com, 1-9.

44. Faure A, York P and Rowe RC: Process control and scale-up of pharmaceutical wet granulation processes: A review. European Journal of Pharmaceutics and Biopharmaceutics 2001; 52(3):269-277.

45. Miyamoto Y, Ryu A, Sugawara S, Miyajima M, Ogawa S, Matsui M, Takayama K and Nagai T: Simultaneous optimization of wet granulation process involving factor of drug content dependency on granule size. Drug Development and Industrial Pharmacy 1998; 24(11):1055-1065.

46. Albertini B, Passerini N, González-Rodríguez ML, Cavallari C, Cini M and Rodriguez L: Wet granulation as innovative and fast method to prepare controlled release granules based on an ionexchange resin. Journal of Pharmaceutical Sciences 2008; 97(3):1313-1324

47. Agrawal R and Naveen Y: Pharmaceutical processing – A review on wet granulation technology. International Journal of Pharmaceutical Frontier Research 2011; 1(1):65-83.

48. Torres-Sua´rez AI and Gil-Alegre ME: Wet Granulation. In: Swarbrick J and Boylan JC (Eds.): Encyclopedia of Pharmaceutical Technology. Marcel Dekker, Inc, New York, Vol. 16, 2001: 363-402.

49. Sahoo PK "Pharmaceutical Technology" Tablets, pp17-19, India: 2007, retrieved December 29, 2014 form www.google.com.

THE END

Coming Soon Next

"THE BEACON EDITION"

IJHEPS/JUNE 2015

ISBN: 978-81-909047-9-7

Website: www.ijheps.org
Facebook: www.facebook.com/ijheps
E-mail: editorboard@ijheps.org

Original Price: 30$
Special Indian Price: Rs.1000