International Journal of Food, Nutrition and Dietetics

International Journal of Food, Nutrition & Dietetics (IJFND) (pISSN 2322-0775; eISSN: 2455-569X), a broad-based peer-reviewed journal publish the most exciting researches with respect to the subjects of nutrition and food sciences. The journal covers current thinking on food and nutrition emphasizing the practical and social application of ideas. Special editions focusing on topics including micronutrients, special diets for management of health problems and cost sector catering provide readable content that is an invaluable resource for practitioners and academics wishing to inform themselves, their colleagues, or the public on modern thinking, research, and attitudes to food and nutrition.

Readership: Academics and researchers in the field, Dietitians, Food company managers, Food research institutes, Health care professionals, Nutritionists

Indexing Information: Index Copernicus, Poland; ProQuest, USA; Genamics JournalSeek; CiteFactor, USA; Cosmos Impact Factor, Germany etc.

For all other quiries Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091 (India), Phone: 91-11-22754205, Fax: 91-11-22754205, E-mail: info@rfppl.co.in, Web:www.rfppl.co.in

Printed at Saujanya Printing Press, D-47, Okhla Industrial Area, Phase-1, New Delhi - 110 020.

International Journal of Food, Nutrition & Dietetics (IJFND) (pISSN: 2322-0775, eISSN: 2455-569X), a broad-based peer-reviewed journal publish the most exciting researches with respect to the subjects of nutrition and food sciences. The journal covers current thinking on food and nutrition emphasizing the practical and social application of ideas. Special editions focusing on topics including micronutrients, special diets for management of health problems and cost sector catering provide readable content that is an invaluable resource for practitioners and academics wishing to inform themselves, their colleagues, or the public on modern thinking, research, and attitudes to food and nutrition.

Readership: Academics and researchers in the field, Dietitians, Food company managers, Food research institutes, Health care professionals, Nutritionists

Indexing Information: Index Copernicus, Poland; ProQuest, USA; Genamics JournalSeek; CiteFactor, USA; Cosmos Impact Factor, Germany etc.

Subscription Information

India
Institutional (1 year) (Print+Online): INR 5000

Rest of the World
Insitutional (1 year) (Print+Online): USD357

Payment instructions
Online payment link:
http://rfppl.co.in/payment.php?mid=15

Cheque/DD:
Please send the US dollar check from outside India and INR check from India made. Payable to 'Red Flower Publication Private Limited'. Drawn on Delhi branch

Wire transfer/NEFT/RTGS:
Complete Bank Account No. 604320110000467
Beneficiary Name: Red Flower Publication Pvt. Ltd.
Bank & Branch Name: Bank of India; Mayur Vihar
MICR Code: 110013045
Branch Code: 6043
IFSC Code: BKID0006043 (used for RTGS and NEFT transactions)
Swift Code: BKIDINBBDOS

Send all Orders to: Subscription and Marketing Manager, Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091(India), Phone: 91-11-45796900, 22754205, 22756995, E-mail: sales@rfppl.co.in, Website: www.rfppl.co.in

International Journal of Food, Nutrition and Dietetics

Volume 5 Number 3
September - December 2017

Contents

International Journal of Food, Nutrition & Dietetics

Library Recommendation Form

If you would like to recommend this journal to your library, simply complete the form below and return it to us. Please type or print the information clearly. We will forward a sample copy to your library, along with this recommendation card.

Please send a sample copy to:

Name of Librarian

Name of Library

Address of Library

Recommended by:

Your Name/ Title

Department

Address

Dear Librarian,

I would like to recommend that your library subscribe to the **International Journal of Food, Nutrition & Dietetics**. I believe the major future uses of the journal for your library would provide:

1. useful information for members of my specialty.
2. an excellent research aid.
3. an invaluable student resource.

I have a personal subscription and understand and appreciate the value an institutional subscription would mean to our staff.

Should the journal you're reading right now be a part of your University or institution's library? To have a free sample sent to your librarian, simply fill out and mail this today!

Stock Manager

Red Flower Publication Pvt. Ltd.

48/41-42, DSIDC, Pocket-II

Mayur Vihar Phase-I

Delhi - 110 091(India)

Phone: Phone: 91-11-45796900, 22754205, 22756995, Cell: +91-9821671871

E-mail: sales@rfppl.co.in

Original Article

International Journal of Food, Nutrition and Dietetics
Volume 5 Number 3, September - December 2017
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.5317.1

Consumer Preference and Quality of Bakery Product - Bread

E. Lakshmi

Abstract

The progress and development in science and technology of baking has resulted in increased awareness of intrinsic nature of ingredients used. Present day bakers have a no. of ingredients that were unknown to their predecessor 20 years ago. *Aims*: To evaluate the quality parameters of raw ingredients used in bread baking and identify the consumer preference in the quality of bread required. *Settings and Design*: 22 bakery outlets. were covered by census method in 18 areas of Chennai city to cover 150 in house bread consumers. *Methods and Material*: Quality parameters of raw ingredients used in bread baking was experimentally done as per –ISI (1985) norms for bread flour . The consumer preference of bread was evaluated by questionnaire. *Statistical analysis used*: Percentage, Likert scale, one way anova and Kolmogorov-Smirinov test (K-s Test) were used. *Results*: The moisture percent of bread flour was significantly (11.9 percent) lesser compared to ISI (13 percent). Most favorable likert score (1.4) was given for appearance of bread and least score(0.5) for packing. *Conclusions*: The quality of ingredients play an important role in determining the quality of end product and consumer preference towards the product.

Keywords: Quality; Raw Ingredients; Bread; Parameters.

Introduction

Bakery products especially bread once considered as a therapeutic diet or tea-time snack has now become an essential daily component of an average Indian house –hold. The progress and development in science and technology of baking has resulted in increased awareness of intrinsic nature of ingredients use[1]. Present day bakers have a no. of ingredients that were unknown to their predecessor 20 years ago. The quality of ingredients play an important role in determining the quality of end product and consumer preference towards the product. There are few bakeries where quality control facilities are available**.** Bakery is a traditional activity and occupies an important place in food processing industry. The bakery manufacturers in India can be differentiated into the three broad segments of bread, biscuits and cake[2]. About 1.3 million tonnes of the bakery products industry in India is in the organized sector out of 3millions tonnes, while the balance comprises of unorganized, small-scale local manufacturer. Though, there are sufficient automatic and semi-automatic bread as well as biscuit manufacturing units in India but there are still number of people prefer fresh bread and other products from the local bakery [3]. Bakery products are an item of mass consumption in view of its low price and with rapid growth and changing eating habits of people, bakery products have gained popularity among masses. The growth rate of bakery products has been tremendous in both urban and rural areas [4]. Bread is a hygienically manufactured and packed snack food product available at comparatively affordable prices.

Author's Affiliation: Head, Department of Nutrition, SRM college of Nursing, SRM University, Kattankulathur, Chennai, Tamil Nadu 603203, India.

Corresponding Author: E. Lakshmi, Head, Department of Nutrition, SRM college of Nursing, SRM University, Kattankulathur, Chennai, Tamil Nadu 603203, India.
E-mail: elakshmi20@gmail.com

Recieved on 14.12.2017, **Accepted on** 16.01.2018

Subjects and Methods

The aim of the study is to evaluate the quality parameters of raw ingredients used in bread baking and identify the consumer preference in the quality of bread. Study was approved by the research committee of SRM Engineering college (M.B.A). The

consumer preference of bread was evaluated by questionnaire method. 22 bakery outlets were covered by census method in 18 areas of Chennai city. To cover 150 in house bread consumers, the flour sample was tested for moisture per centage, water absorption percentage, protein, Gluten, total ash, colour and spores were evaluated as per BIS (1985) [2] norms for bread flour.

Statistical Analysis

Percentage, Likert scale ,one way anova and Kolmogorov-Smirinov test (K-s Test) were used.

Results

Quality of a food is a combination of attributes that determine the degree of acceptability.The moisture per cent of bread flour (Table 1) was lesser by 1.09 per cent (13%) compared to norms of BIS (1969). Lesser the moisture content the water absorption power decreases and acceptable is the flour for bread. The major ingredient that play an important role in the quality of bread is the flour, yeast and fat [5] .

The water absorption power (WAP) was 4 per cent (60%) lesser than the standard. High protein flour produce bread of large volume, uniform air cells and retain enough gas. The protein content was higher than the standard. The gluten content is an important criterion in bread flour. Flour from different suppliers are mixed and standardized in the laboratory by bake test to arrive at the required protein and gluten level. The shelf life at a standard temperature is important in preservation [6]. Quality in Indian Scenario is rarely found in reality. There are few bakeries where quality control facilities are available – hence the present study was conducted.

Standard Values

There was significant difference in purchase of bread by attributes as the calculated value was higher than the table value. Bakery products especially bread once considered as a therapeutic diet or tea-time snack has now become an essential daily component of an average Indian house–hold. Taste was highly important criteria n purchasing bread in 70.7% respondents. The quality of ingredients play an important role in determining the quality of end product and consumer preference towards the product [7]. Major consumers of bread are people from the lower middle class and economically weaker segments consuming more than 90 per cent of the bread industry' s total production Table 2.

Appearance was an important criteria in selecting bread (Table 3) that scored highest of 1.4 in Likert scale. Freshness is eqully important next to appearance. Taste was other important aspect which

Table 1: Evaluation of the quality factors in flour

S. No.	Quality	Bread Flour
1.	Moisture percentage maximum	11.91 (13)
2.	Water absorption percentage maximum	56 (60)
3	Protein (Nx 5.7) Percentage, Dry basis, minimum	14.39 (11.0)
4.	Gluten (Dry basis), Percentage, (maximum)	11.67 (8.5)
5.	Total ash (dry basis) percentage, (maximum)	0.46 (0.5)
6.	Maltose	2 (2-3.5)
7.	Color	Creamy white
8.	pH	(5.5-6.0)
9.	Total bacterial count (gms.)	Nil (100,000)
10.	Bacterial ropes spore count (gms.)	Nil (100)
11.	Shelf life (Months)	3-4 (months)

( ) standard values

Table 2: Attributes in purchase of bread – consumers

Factors	Highly satisfied (A)	Satisfied (B)	Somewhat satisfied (c)	Not satisfied (d)	Highly Not Satisfied (E)	Total	F - Ratio
Appearance	73 (41.3%)	73(46.0%)	2 (11.3%)	1 (0.7%)	1 (0.7%)	150	
Taste	87(70.7%)	45(26.6)	14(1.3%)	3(1.3%)	1(0.7%)	150	4.509
Softness	51 (42.7%)	80 30.7%)	14 (3%)	3 (3.3%)	2 (16%)	150	DF=4,30
Freshness	67 (65.3%)	46 (16%)	13 (0.7%)	22 (0.7%)	2 (17.3%)	150	(2.69)
Nurient content	38 (57%)	52 (30%)	33 (11%)	23 (1%)	4 (1%)	150	
Variety	64 (37%)	36 (22%)	48(37%)	1(3%)	1(1%)	150	
Packing	23 (18%)	65 (28%)	30 (16.7%)	27 9.3%)	5(18%)	150	

Table 3: Most favourable factor in purchase of bread

Weightage	2	1	0	-1	-2	Likert score=
Satisfaction level	1	2	3	4	5	Total weighted score/No of Samples
Attributes						
Appearance	73	73	2	1	1	1.4
Taste	87	45	14	3	1	0.8
Softness	51	80	14	3	2	0.8
Freshness	67	46	13	22	2	1.0
Nurient conent	38	52	33	23	4	0.6
Variety	64	36	48	1	1	1.1
packing	23	65	30	27	5	0.5

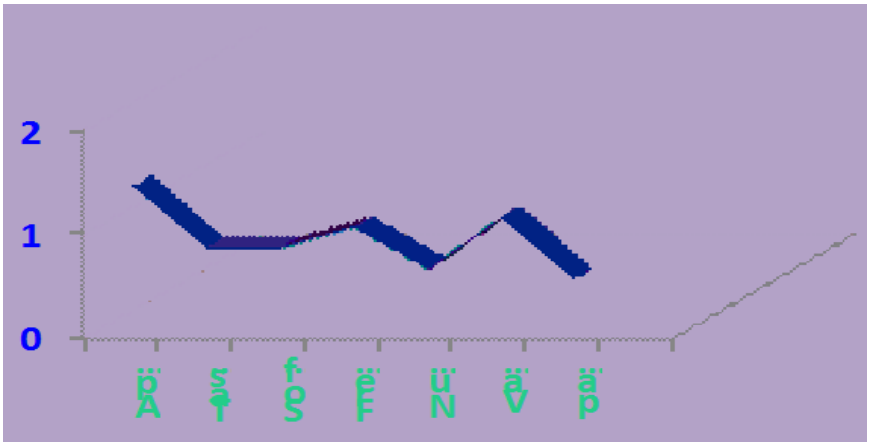

Fig. 1: Most favorable factor - purchase of bread

scored 0..8 in Likert score. when it comes to the customer purchasing appearance is of utmost importance Visual Identity at the retail point is extremely important to generate product off take (Figure 1). Most research in bread quality is based on customer analysis aided by the use of first quality ingredients. The per capita consumption of bakery products in india is about 5-10kgs/annum/personas compared to 50-100kgs in other countries [8].

Discussion

Though bread is not a staple food in the country, its consumption has increased over the years. In India it is still a secondary staple food when compared to chapatti, puri or rice. The brand and quality alone is not just sufficient to boost sales, it is equally important that good packaging,is vital to promote and sell the pro ducts. The shelf life for staple food product like bread is extremely important because consumer also asksfor the fresh bread always, so that it can last long er, Visual Identity at the retail point is extremely important to generate product off take and finaly consumers taste is the most important factor [9].

More then ever the sales people at the counter are a dynamic power in helping the customers in selecting and help in personal selling.

Key Messages

Bakery products especially bread once considered as a therapeutic diet or tea-time snack has now become an essential daily component of an average Indian house-hold. The quality of ingredients play an important role in determining the quality of end product and consumer preference towards the product.

Acknowledgement

I thank the college and the consumers for the support rendered for the study.

References

1. Parimala KR, Sudha ML. Wheat-based traditional flat breads of India.Critical reviews in food science and nutrition. 2015;55(1):67-81.
2. Smith JP, Daifas DP, El -Khoury W, Koukoutsis and

El-Khoury. A. Shelf life and safety concerns of bakery products - A review. Critical Reviews in Food Science and Nutrition. 2004;44:19-55.

3. Edward WP.Science of Bakery Products . RSC Publication. 2007;274.
4. Thanigachalam S, Vijayarani, Consumer behavior towards fast moving consumer goods in Puducherry, Asia pacific Journal of Research. 2014;1(18):130-38.
5. Knudsen B. Consumer attitude towards the bread with wholegrain logo. Aarhus University, Business and Social ciences. 2014;1-42.
6. Bread Industry of India. Retrieved from Bakery Industry: http://www.bakerybazar.com/2010/01/bread-industry-of-india-review.htm.
7. Prateek J. Study of the Britannia Bread Category and its Current Positioning Strategy with the objective of revitalizing the brand 'Britannia Bread. Mysuru. prateekjain14107@sdmimd.ac.in
8. Rajya lakshmi P , Ratna kumari D. Indian bread making tools - consumer availability and use .International Journal of Agricultural Science and Research (IJASR). 2016;6(5):111-16.
9. Rødbotten OT, Holtekjølen SG, Grimsby S.S. Barley bread with normal and low content of salt; sensory profile and consumer preference in five European countries. Journal of Cereal Science. 2015;64:176-82.

Original Article

International Journal of Food, Nutrition and Dietetics
Volume 5 Number 3, September - December 2017
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.5317.2

Evaluation of Antioxidant Capacity and Nutritional Composition of Millet Based Low Cost Weaning Food Formulation

Minaxi R. Prajapati[1], Keshav B. Kamaliya[2], H.H. Chawda[3]

Abstract

Weaning food must be supplied by the age of six months to fulfill the nutritional need of infant. Generally, the weaning foods available in market are prepared by using cereals and are costly. Although millets are equally nutritious, their use is avoided. The research work was planned to formulate millet based weaning food using finger millet, pearl millet and soybean. Different formulations were developed and evaluated sensorily. Formulation with the highest sensory score was considered as experimental formulation (EF) and evaluated for its antioxidant capacity and nutritional content. The EF was prepared by using Pearl millet: Finger millet: Soybean in the ratio of 30:35:35 with powdered Sugar (40%) and Milk Powder (10%). That possessed 13.81 ABTS, 48.83 DPPH and 53.76 FRAP antioxidant capacity. That also contained 13.52g% protein, 6.75g% fat, 2.53g% ash, 1.50g% fiber, 48.34g% carbohydrate, 227.57mg% calcium, 2.77mg% iron and 38.73mg% vitamin-C. It found better in all three types of antioxidant capacity as compared to control thus more beneficial for overall health maintenance. It was also superior in two principal nutrients required for growth and development of infants i.e. protein (17.56%) and fat (44.23%) and two important minerals i.e. calcium (21.66%) and Iron (30.05%) necessary for their bone and blood development, respectively as compared to control. The total antioxidant activities for all the three ABTS, DPPH and FRAP were found higher as compared to control. To meet the nutritional need of infants, 100g of supplementary mix is recommended daily coasting just 5 Rs. The product can be stored for 4 months under ambient condition. Thus a homemade, nutritionally balanced low coast weaning food could be formulated.

Keywords: Weaning Food; Infancy; Millets; Finger Millet; Peral Millet; Soybean.

Introduction

Infancy is period of rapid growth. Weaning food is recommended for the overall growth and complete development after 6 months.

In India, it has been observed that infants do not served special foods. Food which is prepared for other members, same food is served to infant just after altering consistency. In urban areas where mothers are aware, baby food is fed to the infants but are quite expensive. Most of these weaning foods are prepared by using cereals.

Author's Affiliation: [1]Assistant Professor (FN) [2]Principal [3]Associate Professor, Polytechnic in Food Science & HE, Anand Agricultural University (AAU), Anand-388110, Gujarat, India.

Corresponding Author: Keshav B. Kamaliya, Principal, Polytechnic in Food Science & HE, Anand Agricultural University (AAU), Anand-388110, Gujarat, India.
E-mail: kb_kamaliya@yahoo.co.in

Recieved on 26.12.2017, **Accepted on** 16.01.2018

However, millets are ignored in the formulation of weaning food mix. Though that are unique among the cereals because of their richness in calcium, dietary fibre, polyphenols and protein [6], fat, essential amino acids particularly methionine and cysteine [12]. It is well known fact that cereals and millets possess many antinutritional factors which can be reduced by applying various processing techniques. Studies have revealed that germination enhances the nutritive value of cereals and legumes [9, 10, 7] and decrease the levels of antinutrients present in cereals [11].

In the present study finger millet, pearl millet and soybean were used to develop weaning food mix. Finger millet contains high levels of calcium, iron and manganese, its protein is relatively better balanced; it contains more lysine, threonine and valine than other millets. Its carbohydrate, protein, fiber and mineral content are comparable to cereal. Nutritionally pearl millet is comparable and even superior to major cereals with respect of energy value, protein, fat and

minerals. It makes an important contribution to human diet due to high levels of calcium, iron, zinc, lipids and high quality proteins. Besides this, millets are rich source of phytochemicals such as phinolics, âglucan, lignans, phytates sterols, tocopherols, dietary fibers and carotenoids, which act as an antioxidants and boost our immune system [6,8,5]. Soybean stands first to supply both quantity and quality of the protein.

Antioxidants are natural substances found in foods that neutralizes the free radicals and can reduces incidence of disease such as cancer, heart disease and health risk related to aging. The millets and soybean are rich source of antioxidant activity. Various antioxidant activity methods have been used to monitor and compare the antioxidant activity of foods.

Objectives

i. To formulate low coast weaning food by mixing Pearl millet, Finger millet and Soybean.
ii. To standardize the formula using sensory evaluation technique.
iii. To estimate the antioxidant activity and nutritional composition of formulated weaning food.

Methodology

The study was conducted into four parts, process treatment to grain seed, formula optimization to select the best weaning food mix among the various combinations of grains and evaluate the antioxidant capacity and nutritional composition of the selected weaning food mix to judge its possible use in the infant diet. A coast was calculated, dietary recommendations were estimated and a shelf life was also studied as separate part of this long study.

Grain Processing

Both the millets were germinated and soybean was pressure cooked and dehulled before milled to fine dry powder. The process parameters were standardized for soaking, germination, pressure cooking and drying based on laboratory trials conducted based on literature.

Formula Optimization

Formula optimization was carried out by mixing processed powder of White Finger millet, Pearl millet and Soybean. Combination was made in such a way that, the quantity of any one ingredient ranged from 10 to 50 percent (at an interval of 10 percent) and rest two ingredients in equal quantity to make 100 percent. Thus total fifteen combinations of weaning food formulations were prepared into three phases. In each combination 10 percent milk powder and 40 percent powdered sugar were added.

Before serving, 25 g of weaning food mix was added in 150ml of water and cooked for 3 minutes after getting boiled and served immediately to the semi trained panel of 7 judges into 3 replications for sensory evaluation using 9 point Hedonic rating scale. From each phase one highly accepted mix was selected and further sensory and nutritional analysis were carried out. The formulation scored sensorily the heights, considered as experimental formulation and used for the further experimentation.

Nutritional Evaluation

Highly accepted three mixes were analyzed in triplicate for proximate composition [1]. Total carbohydrate was calculated by difference and energy content was calculated by factorial method. Irons, calcium, crude fiber, ash were analyzed by [2] method. Protein was analyzed by Kjeldahl method while fat content by solvent extraction method.

Antioxidant Activity Evaluation

Various antioxidant activity methods have been used to monitor and compare the antioxidant activity of foods. In the present experiments, three methods of analyzing total antioxidant capacity are used.

i. 2,2 Azinobis, 3 Ethyl Benzothiazolin-6-Sulphonic Acid , radical scavenging activity (ABTS RSA) [13].
ii. 2,2-diphenyl-1-picrylhydrazyl, radical scavenging activity (DPPH RSA) [4].
iii. Ferric reducing antioxidant power assay (FRAP assay) [3].

Data Analysis

The standard SPSS programme was run to analyses the data on mean, SEM, CV, CD. All the data was tested for significance using the ANOVA / Ducncan's test [14].

Results and Discussion

Results obtained are presented into two subheadings,

formula optimization and analysis of nutritional composition. Results on coast calculation, shelf life study and dietary recommendations are also mentioned at the last in nutshell from the other part of this long study.

Grain Processing

Both the millets were germinated and soybean was pressure cooked and dehulled before milled to fine dry powder. The standardized processing illustrated in figure 1.

Formula Optimization

The best accepted combination from each phase found is listed in Table 1. Among that combinations formula for phase III (Pearl millet:Finger millet:Soybean in the ratio of 30:35:35) scored the highest in all the sensory attributes. Thus it was selected as an experimental formulation.

Nutritional Composition

The *protein* content for phase II formulation was found the highest followed by Phase III and both were significant. However, both were significantly differ from Phase I formulation and control. The experimentally selected mix contains 17.56% more protein as compared to control. That is beneficial for the infants for their rapid growth.

The *fat* content was increased significantly in all the three formulations as compared to control. The rise was found slightly less than half. Thus the developed formulation beneficial for infants as they required more energy per unit of weight as compared to adults for their constant activity.

Carbohydrate was increased for Phase I and III formulations while decreased in Phase II mixes as compared to control. However the difference was just 5 g%. *Ash and Fiber* content was decreased significantly at 25.14% and 32.00%, respectively.

Calcium and Iron, the most important minerals for

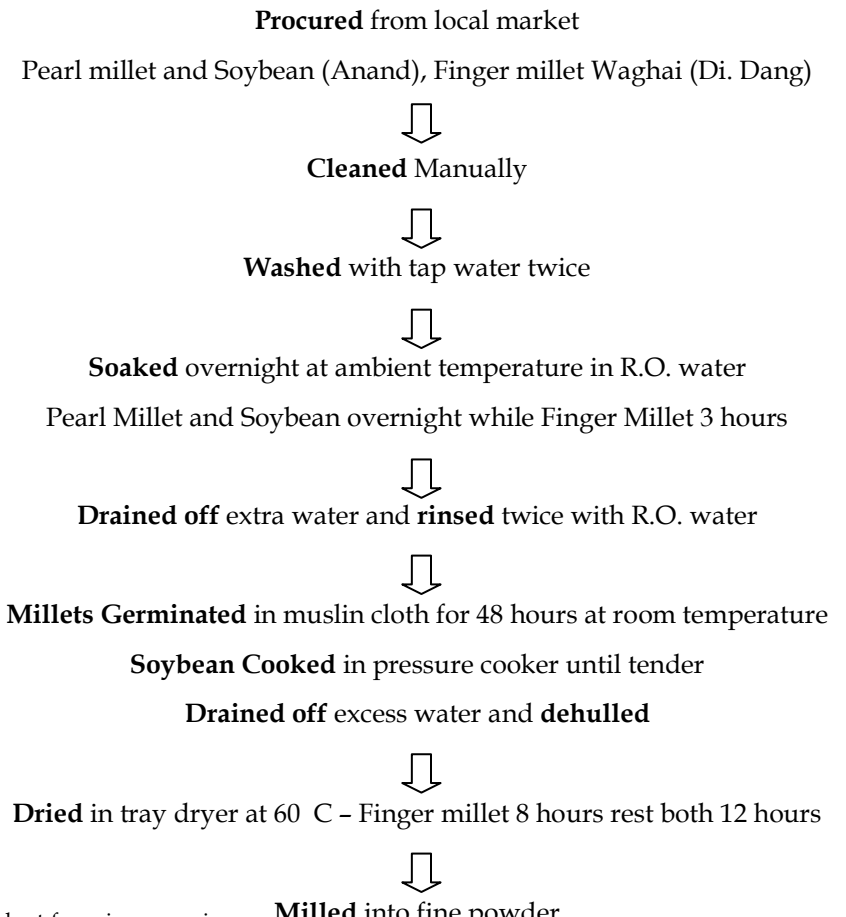

Fig. 1: Flow chart for grin processing

Table 1: Phase wise best accepted formulations

Phase	Pearl Millet (%)	Finger Millet (%)	Soybean (%)
I	35	35	30
II	40	20	40
III	30	35	35

Table 2: Nutritional composition of the selected weaning food formulations

Phase	Protein (g%)	Fat (g%)	Ash (g%)	Fiber (g%)	Carbohydrate (g%)	Calcium (mg%)	Iron (mg%)	Vitamin C (mg%)
I	11.88^{a} ±0.50	6.32^{b} ±0.25	2.15^{a} ±0.12	1.55^{a} ±0.17	46.41^{b} ±1.30	206.80^{ab} ±8.07	6.19^{c} ±0.48	35.27^{a} ±3.10
II	14.61^{b} ±0.24	6.59^{b} ±0.27	2.73^{ab} ±0.33	1.35^{a} ±0.15	39.80^{a} ±1.79	205.13^{ab} ±6.90	1.55^{a} ±0.03	56.77^{b} ±4.62
III	13.52^{b} ±0.35	6.75^{b} ±0.42	2.53^{a} ±0.18	1.50^{a} ±0.11	48.34^{b} ±1.06	227.57^{b} ±13.14	2.77^{b} ±0.18	38.73^{a} ±1.60
Control	11.5^{a} ±0.44	4.68^{a} ±0.45	3.38^{b} ±0.24	2.23^{b} ±0.09	44.24^{ab} ±2.25	187.06^{a} ±4.49	2.13^{ab} ±0.20	39.67^{a} ±1.19
SEM	0.40	0.36	0.23	0.13	1.67	8.74	0.27	2.96
CD	1.22	1.11	0.71	0.41	5.13	26.94	0.85	9.11
CV	6.14	11.81	17.19	16.05	7.45	8.46	17.37	13.87

Values are Mean ± SEM of nutritional analysis
Means bearing the same superscript within the column do not differ significantly ($p \leq 0.05$)
Cereal based weaning food mix available in market treated as control

Table 3: Antioxidant capacity of selected weaning food formulation

Phase	ABTS	DPPH	FRAP
I	10.15±0.58	39.48±0.91	45.47±1.29
II	14.06±0.36	43.92±2.56	48.93±1.64
III	13.81±0.40	48.83±3.69	53.76±1.16
Control	12.36±0.68	40.33±1.46	39.50±1.47
SEM	0.52	2.41	1.40
CD	1.62	7.42	4.33
CV	8.37	11.17	6.00

Values are Mean ± SEM of antioxidant capacity

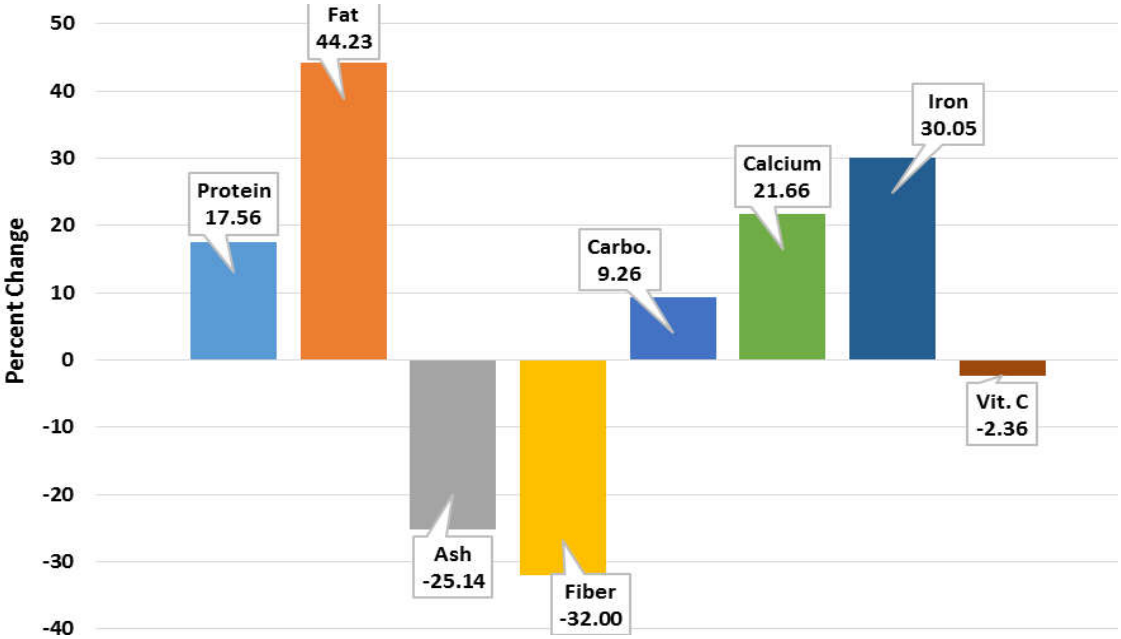

Chart 1: Percentage change in nutritional composition of experimental mix

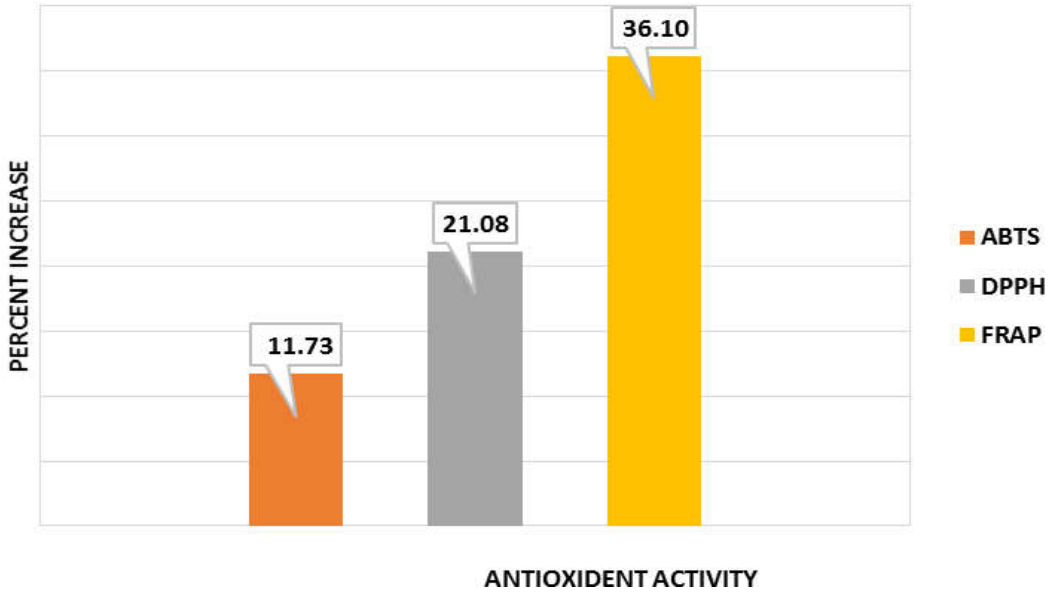

Chart 2: Percentage increase in antioxidant activity of experimental mix

bone and teeth development and blood, respectively and thus found the most valuable for the children were increased. The positive change for experimental formulation were 21.66 mg% and 30.05 mg% for Calcium and Iron, respectively as compared to control.

Vitamin C content was almost similar for both control as well as experimental formulation.

Antioxidants Capacity

Total antioxidant capacity is a measure which shows the combined action of all antioxidant compounds present in a specific food. The mean values are depleted in Table 3. Sample phase II showed the highest (14.06) ABTS % inhibition followed by phase III (13.81) and Phase I.

However, DPPH and FRAP (as TAC) % inhibition both were found the highest for finally selected product i.e 48.83 and 53.76, respectively. All the three activities were found higher as compared to control. The percent increment for ABTS, DPPH and FRAP was 11.73, 21.08 and 36.10% inhibition as shown in chart 2.

Other Finding

Cost of formulated mix was just Rs. 5.00 per 100 g, which is about 5 times less than the most weaning food mixes available in the market. One serving of formulated millet based weaning food provide 3.38g protein, 1.69g fat, 12g carbohydrate, 56.89mg calcium and 0.69g iron. To meet the nutritional need of infants, 100g of supplementary mix is recommended daily. The product can be stored for 4 months under ambient condition.

Conclusion

Millet based nutritionally balanced, homemade, low coast weaning food could be formulated. That contained more protein, fat, calcium and iron, the most beneficial nutrients for infants. It also superior in antioxidant activity. The product could be stored for sufficient time. That could be easily prepared and fed by rural mothers for their infants as supplementary food.

References

1. AOAC. Official methods of analysis. Association of official analytical chemist (13th edition), Washington DC. 1980.
2. AOAC. Official methods of analysis. Associ-ation of official analytical chemist, Washington DC. 1990.
3. Benzie I, Strain J. Ferric Radical Antioxidant Power assay; Direct measure of total antioxidant activity of biological fluid and modified version for simultaneous measurement of total antioxidant power and ascorbic acid concentration. Method Enzymology 1999;15:27.
4. Bran Williums M, Cuvelier, C Berset. Use of free radical method to evaluate antioxidant activity.

Lebens mittel Wissenschaft and Technology. 1995;28:25-30.

5. Chandrasekara A, Shahidi F. Content of insoluble bound phenolics in millets and their contribution to antioxidanant capacity. J Agric Food Chem 2010; 58:6706-14.
6. Devi PB, Vijayabharathi R, Sathyabama S, Malleshi NG, Priyadarisini VB. Health benefits of finger millet (*Eleusinecoracana L.*) polyphenols and dietary fiber : a review. J Food Sci Technol 2011; DOI: 10.1007/s13197-011-0584-9.
7. Hansen M, Pederdern B, Munck L, Eggum BO. Weaning foods with improved energy and nutrient density prepared from germinated cereals. I Preparation of dietary bulk of gruels based on barley. Food Nutr Bull 1989;11:40-44.
8. Liu R.H. Whole grain phytochemicals and health. J Cereal Sci 2007;46:207-19.
9. Marero LM, Payumo EM, Librando EC, Lainez W, Gopez MD, Homma S. Technology of weaning food formulations prepared from germinated cereals and legumes. J Food Sci 1989a;53:1391-95.
10. Marero LM., Payumo EM, Aguinaldo AR, Homma S. Nutritional characteristics of weaning foods prepared from germinated cereals and legumes. J Food Sci 1989b;53:1399-1402.
11. Nkama I, Ikwelle MC. Assessment of food quality of millet grain. in: Emechese AM, Jikwelle MC, Ajayi D, Amina-kano M and Anaso AB, editors. Pearl millet in Nigerian agriculture: Production, utilization and research priorities. Proceedings of the preseason national coordination and planning meeting of the nationally coordinated research programme on pearl millet, Maiduguri, 21- 24th April, 1997. Lake Chad Research Institute, Maiduguri, Nigeria 1998.p.177-8.
12. Obilana AB, Manyasa E. Millets. In: PS Belton, JRN Taylor (Eds.). Pseudo cereals and less common cereals: Grain properties and utilization potential. Springer-Verlag, New York 2002.p.177–217.
13. Re N, Pellegrini A, Proteggente A, Pannala M. Yang and Rice Evans. Antioxidant activity applying an improved ABTS radical cation decolorization assay. Free Radical Biology 1999;26:1231-37.
14. Steel RGD, Torrie HH. Principles and Procedures of Statistics. McGraw Hill Co., New York 1960.

Original Article

International Journal of Food, Nutrition and Dietetics
Volume 5 Number 3, September - December 2017
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.5317.3

Organoleptic, Physico-Chemical and Nutritional Parameters of Gherkin Pickles Prepared with Indian Spices

Madhusmita Sahoo[1], Jamuna Prakash[2]

Abstract

India is regarded as the 'Home of Spices'. Alarge proportion of the spices imported globally every year comes from India. Use of such spices in traditional foods like pickles occupies an important place among the processedfoods in India. India is the second largest vegetable producer in world. Hence, processing of vegetables with traditional Indian spices has good scope for the trade development overseas. Different variants of gherkin(Cucumisanguria)pickles were developed using traditional Indian spices available locally. The pickles were packed in glass jars through aseptic packing technology by vacuum sealing and pasteurization. The developed pickles were studied for thephysico-chemical properties and sensory attributes soon after pasteurization and after 15 days of stabilization period. Further, the effect of heat treatment/pasteurization on the nutritional profile of the developed pickles after 15 days of stabilization period was studied.The study showed that use of spices in either fresh or dehydrated form, enhanced the sensory profile of gherkin pickles. The four variants of spice based picklesdeveloped, were well accepted among the panelistpre- and post-stabilization. The addition of spices enhanced the nutrient content of the pickles when compared with plain gherkin vegetables.Though this study focused only on gherkin pickles, Indian spices can be very well explored in other vegetable products that can be processed and stored for longer time.

Keywords: Gherkin; Spice; Vacuum Sealing; Pasteurization; Osmosis; Stabilization.

Introduction

Processed vegetables account for approximately 42-45 million tons of the total world production and undergo varying degree of processing. However, in Asia, vegetables are mainly processed for preparing pickles. The main suppliers of Asian vegetables to export market for processing are India, China, Thailand and Vietnam [1].

Presently, India is listed second forthe vegetables production in the world. The production of vegetables in India has touched 295 MT (2015-16), from about 145.8 MT in 2001-02 [2]. Owing to the fact that India is the second largest vegetable producer, every year large quantities of vegetables are wasted due to lack of proper and protected storage. This can be very well prevented using different processing and preservation technology. This will help in storing the vegetables for longer time and they can also be exported to other countries. One such vegetable which has emerged as a potential export-oriented delicacy is the 'gherkin', popularly known as 'pickling cucumber'. This vegetable alone has the potential of fetching foreign exchange worth Rs. 1,500 million from 50,000 tons of produce every year. Today it is the only 100% export-oriented commodity from the country [3].

The history and culture of Indian spices and condiments are probably as old as human civilization itself. In spite of the industrial advancement of India in modern times, this country is still regarded as the 'Home of Spices'. This is due to the fact that the quality of the spices produced in and exported from this country continues to be the best. An impressive 46% of the spices imported globally every year, comes from India.

While India exports processed gherkins and spices separately to the global market, the possibility of exporting both together in processed form is not

Author's Affiliation: [1]Research Scholar [2]Retired Professor, Department of Food Science and Nutrition, University of Mysore, Manasagangotri, Mysore, Karnataka 570006, India.

Corresponding Author: Madhusmita Sahoo, Research Scholar, Department of Food Science and Nutrition, University of Mysore, Manasagangotri, Mysore, Karnataka 570006, India.
E-mail: madhusmita24@yahoo.co.in

Recieved on 02.01.2018, **Accepted on** 16.01.2018

explored in a systematic way so far by the Indian gherkin industries. Hence, in present investigation, an effort is put to study the processing aspects of gherkins/cucumber pickling in combination with Indian spices in vacuum sealed glass jars. The emphasis is placed on the development and standardization of spice based gherkin pickles keeping in view the organoleptic parameters associated with Indian spices. The study further details the physico-chemical and nutritional parameters of the developed pickles with added spices in fresh and dehydrated form.

Materials and Methods

Materials

Selection of Raw Materials

Ajax variety of the Gherkins (*Cucumis anguria*),were selected for the pickles/product development with various spices like onion, garlic, dill leaves, dry red chili, black pepper, cumin seeds and yellow mustard. While fresh spices were obtained locally from the farmers in and around Bangalore, the dry and dehydrated spices were procured from the approved traders in India. Pickles generally contain ingredients such as salt, vinegar,sugar,spices and water as described by *Sandhu and Shukla* (1996) [4]. For this study, those ingredients such as salt, calcium chloride, natural vinegar, and colour were procured from the industrial supply shop and were of food grade nature.

Methods

Steps in Processing

Various steps associated in pickling process was described and discussed in detail by Cruess [5]. For this study, similar steps were adopted for the processing of gherkins with spices after the harvest

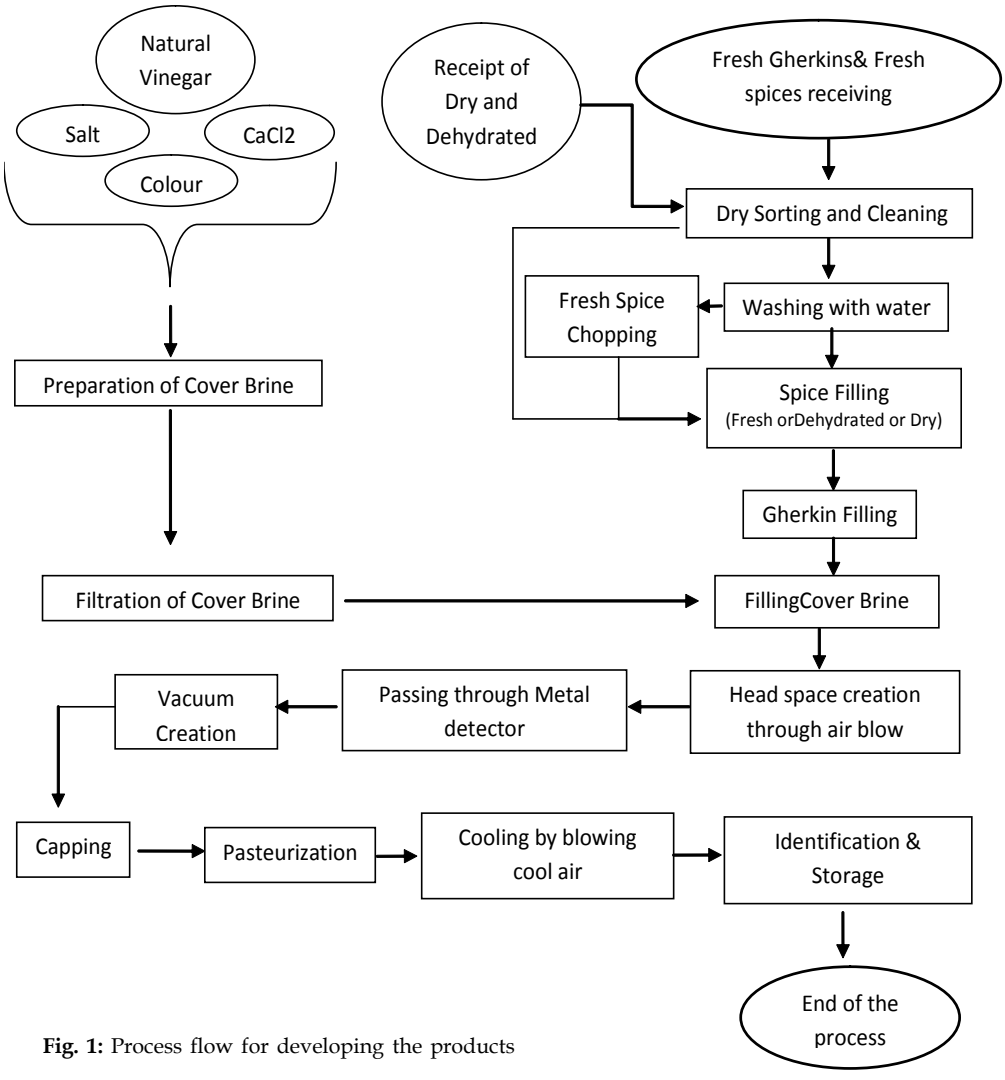

Fig. 1: Process flow for developing the products

as given in Figure 1 and are detailed below.

Reception: To ensure less time spent on the transportation, fresh gherkins were received directly from the farmers within 60 to 80 km periphery of the industry. Further the gherkins were stored in controlled temperature and processed within 24 hours of the harvest to avail the benefit of maximum freshness. The fresh dill leaves, onions and garlic were procured early morning on day of processing directly from the farmers or traders and were stored in the cold storage (between 8^0C to 15^0C) till further processing.

The dehydrated and dry spices and other ingredients (salt, calcium chloride, natural vinegar, and colour) were inspected for the quality parameters and stored till further processing.

Washing: Washing of the freshly harvested gherkins and dill leaves were done using water to remove soil. Gherkins were checked visually for any mold infection or bruises. The dill leaves were sorted out by removing the roots and weeds prior to washing and cutting. Fresh onions and garlic were sorted out to remove the rotten and fungus infected ones followed by peeling, washing and chopping.

Gherkin Selection: The washed gherkins were inspected on a conveyer belt to sort out crooked and bent vegetable and to remove flowers, stalks, damaged and infected vegetable. Clean, fresh, good green gherkins were selected for further processing.

Grading: Grading of gherkin is carried out on the basis of count per kg. The grade of 60/80 (count per kg was an average of 60 to 80 gherkins), was selected for this study.

Packaging Container: 500mlcapacity of glass jars and metal caps of 77 mm diameter with food grade liner were selected to pack the gherkin pickles.

Cover Brine Preparation: Acidic media or cover brine having pH less than 3.2 , is used as preservative for pickles to enhance the taste of the product. For this study, cover brine was prepared using potable water as stated by Sandhu *et al.* [4] with natural vinegar (13% pure acetic acid), salt, colour and calcium chloride which is used as firming agent to ensure crispiness post pasteurization [6].

Capping: The capping of the jars was done automatically by the Capping machine (model-EMRITO 2.8 and Make-Spain). A minimum 100 mbar vacuum was maintained to ensure long product shelf life when combined with an effective pasteurization process.

Pasteurization: The optimum processing conditions for pasteurization at a process temperature of 70^0C was proposed by Rodrigo and Alvarruiz [7]. The products developed for all the variants were pasteurized between 80 to 85°C for 12 to 18 min to obtain the minimum *core temperature* of the gherkin at 70°C, as suggested by Rodrigo and Alvarruiz [7] to inhibit/eliminate the viable microbial load (pathogens).

Core Temperature: The maximum temperature achieved at the cold spot of a gherkin while the pickle jars are passed through the hot zone of the pasteurizer is called the '*core temperature*'. The cold spot is the center point between 2/3rddistancefrom the gherkin tip and 1/3rdfrom the bottom of the gherkin. This is the point where the minimum temperature is checked to ensure the effective pasteurization that kills viable microbial load.

QA Check

Product Development

New products were developed keeping 'spice/s' as important ingredients in all formulations. Total four variants of pickled gherkins were developed (Table 1) out of which three variants were developed using Dill leaves and spices in fresh and dehydrated form. One variant was developed without dill leaves but using other commonly consumed Indian spices like cumin seeds, whole black pepper and dry red chili.

For standardization, each of the formulation mentioned above were subjected to 5-7 trials till an acceptable product evolved. The criteria of colour, texture and the overall acceptance was considered for standardizing the formulations. For each spice variant, a total of 36 jars were produced in every trial.

Quality Control and Laboratory Analysis

Quality Control is an important aspect in gherkin pickling and consists of the steps like cover brine preparation, physical checking, organoleptic evaluation and laboratory analysis. All these parameters were evaluated soon after the packing and pasteurization and also after the stabilization period of 15 days from the date of packing.

Physical Analysis: The pickled gherkins were evaluated for correct grade, gherkin count per jar, spice quantity, vacuum, head space and cap security.

Chemical Analysis: The methods defined by Ranganna[8] were adopted to analyze the chemical parameters like pH, acidity as acetic acid, salt and calcium quantity in ppm.

Nutrient Analysis: Uthpala et al [9], studied the proximate and mineral composition of locally grown gherkin varieties. A similar effort was taken to study the proximate parameters (energy, carbohydrate, protein and fat) and the vitamin C and Calcium content of the developed pickles after 15 days of stabilization period, following AOAC [10] methods.

Organoleptic Evaluation

Few studies have been conducted on the development of the terms or descriptors used to describe pickle flavour and the other sensory parameters responsible for the characteristic pickle taste and aroma. One such study was conducted by Zhuk[11], who described a method based on 5-point scale for panel evaluation of organoleptic quality of pickled cucumber. Similar method was adopted to evaluate the sensory attributes like colour, texture, crispiness and flavour profile of the developed pickles.

Statistical Analysis

The data of nutritional analysis were considered in triplicates for analyzing the mean and standard deviation. Similarly, the results of sensory evaluation were subjected to statistical analysis using Students T test between fresh and stabilized samples fixing the probability level of 0.05. The values represent mean and standard deviation of analysis result and sensory scores respectively.

Result and Discussion

The physico-chemical properties of the pickles developed with various spices, soon after the development and after a stabilization period of 15 days are listed in the Table 2 to Table 5. The level of the ingredients and additives/chemicals which are added to the media determines the process of pickling and preservation.

Physico- Chemical Properties of Gherkin Pickles with Various Spices

A. SP 1-Pickles with fresh spices (Dill leaves, Onion and garlic)

While same grade of gherkin (60/80) was used to pack all the jars, the count of the gherkins varied from jar to jar. The average count of gherkins per kg was 72.2 during the packing and an average of 19.6 numbers of gherkins was packed in each jar. The head space was lower initially; however, it increased after stabilization. This is due to the osmosis process that takes place during the stabilization period, leading to loss of water from the gherkins and the same water is replaced by the vinegar based cover brine to result in the characteristic pickle flavour. There was an increase in calcium content post-stabilization, whereas acidity and pH recorded a decrease.

Aseptic /vacuum sealing is referred to as one of the many hurdle technologies in obtaining the microbial safety of pickled fruits and vegetables [12]. Vacuum or hypobaric packaging technique also acts as preservation technique [13]. The vacuum of the jars were initially kept constant at 100 mbar of Hg at the time of development. However, the same increased to nearly 3 times high with an average vacuum of 280mbar after stabilization. An increase in the vacuum is a proof for a tamper proof aseptic sealing.

Kuwahara *et al.* [6] reported that addition of calcium chloride to cucumber pickles increased firmness to direct proportions to calcium level present in the pickles. In the present study, the calcium level increased from 351 to 473 ppm indicating the natural source of calcium content contributed by gherkins and the spices.

B. SP-2-Pickles with dehydrated spices (Dill leaves, Onion and garlic)

A slightly different trend was observed in the physico-chemical parameters of the pickles when packed with the same spices but in the dehydrated form. The detailed parameters are listed in Table 3.

While a maximum 100m bar vacuum was found in fresh pickle, the stabilized jar had maximum of 250 mbar vacuum. There was reduction in the acidity content from 0.8% to 0.71%. The calcium content increased significantly. The pH of the product was initially 4.0 and reduced to 3.83 after stabilization. As noted earlier, these changes signify the process of osmosis in pickles and indicate stabilization.

C. SP-3-Pickles with cumin seeds, dry pepper and dry red chilli.

Table 4 shows the Physico-chemical parameters of the gherkin pickles made with cumin seeds, dry pepper and dry red chili. While there was a combination of increased and decreased levels of different parameters observed in the two variants of pickles mentioned above, for this particular variant, the levels were decreased after the pickles were stabilized for a period of 15 days.

The acidity and salt levels were reduced to 0.62%

and 1.12% from 0.74 % and 1.23% respectively. The pH of the product decreased from 4 to 3.8 signifying the process of osmosis in pickles and indicating stabilization.

D. SP-4-Pickles with dehydrated dill leaves, yellow mustard and fresh onion

This is the only variant which was tried with a combination of spices in all three forms. While the dill leaves used were in dehydrated form, there was fresh onion and dry yellow mustard used in this variant of pickles. The physico-chemical parameters are presented in Table 5. Like other variants, the parameters like acidity and salt decreased from 0.71% and 1.30% to 0.63% and 1.18% respectively. Head space decreased from 10.6 mm to 8.6mm.In the present study, the calcium level increased from 299 to 457 ppm adding to the product crispiness as reported by the study conducted by Kuwahara *et al.* [6].

Sensory attributes of Gherkin Pickles

Consumer acceptance of the freshly packed gherkin pickles is very much dependent on the organoleptic criteria in the overseas market. The main sensory attributes of gherkin pickles are recognized as the colour, crunchy bite/crispiness and the overall flavour profile. This is because, some vegetables used in pickling are very heat sensitive and quality indicators such as colour and texture are usually degraded to a large extent during thermal treatment or pasteurization process [14]. Further Fresh cucumber pickles especially when refrigerated, develop a characteristic flavour. The investigative study by Harris *et.al* (2002) [15] have demonstrated a strong dependence between product pH and the ability of refrigerated cucumber to produce flavor components that characterize fresh cucumber flavor. India is considered as the "Home of Spices" and every spice in India is known for its unique aroma and flavour components. Addition of spices imparts

Table 1: Details of Formulations of Spice variant Gherkin pickles

SP 1	SP2	SP3	SP4
Gherkins	Gherkins	Gherkins	Gherkins
Water	Water	Water	Water
Salt	Salt	Salt	Salt
Vinegar	Vinegar	Vinegar	Vinegar
Calcium Chloride	Calcium Chloride	Calcium Chloride	Calcium Chloride
Color	Color	Color	Color
Fresh Dill leaves	Dehydrated dill leaves	Cumin seeds	Dehydrated dill leaves
Fresh Onion	Dehydrated onion	pepper	Yellow mustard
Fresh Garlic	Dehydrated garlic	Dry red chilly	Fresh Onion

Table 2: Physico-chemical properties of fresh and stabilized product: Spice Variant 1 (SP 1)

Properties	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Mean
Freshly prepared products						
Grade	60/80	60/80	60/80	60/80	60/80	60/80
Count Per Kg in No.	73	71	73	73	71	72.2
Vaccum in mbar	100	100	100	100	100	100
Security in mm	5	6	5	5	6	5.4
Head Space in mm	9	8	9	9	10	9
Acidity in %	0.66	0.66	0.66	0.6	0.66	0.65
Salt in %	1.34	1.28	1.28	1.34	1.34	1.3
Calcium in ppm	333	335	380	375	331	351
pH	4.1	3.87	3.87	3.91	4.1	4
Stabilized Products after 15 days						
Grade	60/80	60/80	60/80	60/80	60/80	60/80
Count Per Jar in No.	20	19	20	20	19	19.6
Vaccum in mbar	300	250	300	300	250	280
Security in mm	6	7	7	7	6	6.6
Head Space in mm	7	12	10	10	9	9.6
Acidity in %	0.6	0.6	0.6	0.66	0.6	0.6
Salt in %	1.28	1.28	1.34	1.34	1.28	1.3
Calcium in ppm	481	481	481	442.1	481	473
pH	3.7	3.74	3.81	3.83	3.71	3.76

Table 3: Physico-chemical properties of fresh and stabilized product: Spice Variant 2 (SP 2)

Properties	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Mean
Freshly prepared products						
Grade	60/80	60/80	60/80	60/80	60/80	60/80
Count Per Kg in No.	73	72	72	72	73	72.4
Vaccum in mbar	100	100	100	100	100	100
Security in mm	6	7	7	7	7	6.8
Head Space in mm	10	11	11	12	11	11
Acidity in %	0.86	0.78	0.78	0.86	0.78	0.8
Salt in %	1.34	1.28	1.28	1.22	1.34	1.3
Calcium in ppm	285	302	288	285	285	289
pH	4	4	3.97	3.91	4	4
Stabilized Products after 15 days						
Grade	60/80	60/80	60/80	60/80	60/80	60/80
Count Per Jar in No.	21	20	20	22	20	20.6
Vaccum in mbar	250	200	250	300	250	250
Security in mm	6	6	7	6	6	6.2
Head Space in mm	8	8	10	8	8	8.4
Acidity in %	0.72	0.72	0.66	0.72	0.72	0.71
Salt in %	1.28	1.34	1.22	1.28	1.22	1.27
Calcium in ppm	481.2	444.1	481.2	442.1	444.1	458.5
pH	3.83	3.84	3.73	3.84	3.93	3.83

Table 4: Physico-chemical properties of fresh and stabilized product: Spice Variant 3 (SP 3)

Properties	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Mean
Freshly prepared products						
Grade	60/80	60/80	60/80	60/80	60/80	
Count Per Kg in No.	72	74	72	70	73	72.2
Vaccum in mbar	75	100	100	75	100	90
Security in mm	6	7	7	6	6	6.4
Head Space in mm	10	9	10	11	9	9.8
Acidity in %	0.72	0.78	0.78	0.72	0.72	0.74
Salt in %	1.22	1.22	1.22	1.22	1.28	1.23
Calcium in ppm	302	302	288	288	285	293
pH	3.91	4	4.03	3.91	4	4
Stabilized Products after 15 days						
Grade	60/80	60/80	60/80	60/80	60/80	
Count Per Jar in No.	20	21	21	21	21	20.8
Vaccum in mbar	350	300	350	350	250	320
Security in mm	6	6	7	6	6	6.2
Head Space in mm	8	8	10	8	8	8.4
Acidity in %	0.6	0.6	0.66	0.66	0.6	0.62
Salt in %	1.11	1.11	1.11	1.14	1.14	1.12
Calcium in ppm	441	481	481.2	441	444.1	457.6
pH	3.84	3.73	3.9	3.83	3.72	3.80

characteristic flavour to the dishes made. While consumers relate the flavour profile of traditionally made pickles loaded with spices, very few studies are conducted on the addition of spices to the gherkin pickles and the impact on the flavor components of the pickles.

The developed pickles with various Indian spices were evaluated by skilled and semi-skilled panelists (employed with the gherkin processing Industry) for the attributes like texture, colour,flavour and crispiness based on the 5-point scale method described by Zhuk (1991) [11].The retention of characteristic texture, flavour and crispiness after the completion of osmosis process post 15 days of stabilization was a challenge as there are many instances reported overseas on the rejection of pickles at retail level, due to improper texture or flavor or due to sogginess. The present study confirmed that the flavour of cucumber pickle products varies widely, depending upon the type of spices and the form in which the spices are added to the final product, as identified earlier by Fleming *et al.* [16].

Table 5: Physico-chemical properties of fresh and stabilized product : Spice Variant 4 (SP 4)

Properties	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Mean
Freshly prepared products						
Grade	60/80	60/80	60/80	60/80	60/80	
Count Per Kg in No.	75	72	73	72	71	72.6
Vaccum in mbar	100	100	100	100	100	100
Security in mm	7	6	7	7	7	6.8
Head Space in mm	10	11	11	10	11	10.6
Acidity in %	0.72	0.72	0.66	0.72	0.72	0.71
Salt in %	1.34	1.34	1.28	1.28	1.28	1.30
Calcium in ppm	302	302	302	288	302	299
pH	3.87	3.84	3.91	3.91	3.84	3.87
Stabilized Products after 15 days						
Grade	60/80	60/80	60/80	60/80	60/80	
Count Per Jar in No.	19	20	21	19	19	19.6
Vaccum in mbar	150	250	150	250	250	210
Security in mm	7	6	7	7	6	6.6
Head Space in mm	7	9	10	7	10	8.6
Acidity in %	0.66	0.66	0.6	0.66	0.6	0.63
Salt in %	1.22	1.22	1.14	1.14	1.22	1.18
Calcium in ppm	481.2	441.1	441.1	481.2	441	457
pH	3.82	3.9	3.76	3.74	3.78	3.8

Table 6: Sensory attributes of Fresh and Stabilized Products

	Day	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
SP 1						
Colour	0	4.00 ± 0.286	4.00 ± 0.085	3.9 ± 0.35	4.00 ± 0.252	4.00 ± 0.244
	15	4.00 ± 0.115^{ns}	3.2 ± 0.316***	3.5 ± 0.408 ^{ns}	4.00 ± 0.183^{ns}	4.00 ± 0.085^{ns}
Texture	0	3.8 ± 0.27	4.00 ± 0.23	4.00 ± 0.15	3.5 ± 0.15	4.0 ± 0.28
	15	3.9 ± 0.21 ^{ns}	3.8 ± 0.29^{ns}	3.8 ± 0.39*	4.5 ± 0.18***	4.5 ± 0.13***
Crispiness	0	3. 8 ± 0.23	3.8 ± 0.27	3.5 ± 0.42	4 ± 0.3	4.00 ± 0.21
	15	4.00 ± 0.08**	3.4 ± 0.44	4.5 ± 0.2**	4.00 ± 0.28 ^{ns}	4.00 ± 0.28^{ns}
Flavour	0	3.5 ± 0.32	4.2 ± 0.27	4.5 ± 0.13	4.00 ± 0.12	4.5 ± 0.13
	15	3.90 ± 0.33**	3.8 ± 0.32**	4.00 ± 0.17***	4.2 ± 0.23*	4.2 ± 0.25***
SP 2						
Colour	0	3.8 ± 0.3	3.8 ± 0.21	3.9 ± 0.27	4.00 ± .22	4.00 ± 0.20
	15	4.00 ± 0.31*	4.20 ± 0.3***	4.0 ± 0.34 ^{ns}	4.00 ± 0.22^{ns}	4.00 ± 0.08^{ns}
Texture	0	3.3 ± 0.36	3.8 ± 0.35	3.8 ± 0.35	4.00 ± 0.31	4.00 ± 0.46
	15	4.0 ± 0.08***	3.5 ± 0.33**	4.5 ± 0.09***	4.0± 0.15 ^{ns}	4.50 ± 0.11***
Crispiness	0	3.5 ± 0.09	3.50 ± 0.27	3.50 ± 0.36	3.5 ± 0.24	4.0 ± 0.22
	15	4.00 ± 0.13***	4.0 ± 0.3***	4.00 ± 0.2***	4.00 ± 0.35***	4.00 ± 0.27 ^{ns}
Flavour	0	3.50 ± 0.32	4.2 ± 0.21	4.0 ± 0.28	4.00 ± 0.20	4.00 ± 0.07
	15	3.0 ± 0.27***	3.5 ± 0.32***	4.00 ± 0.23 ^{ns}	4.0 ± 0.09 ^{ns}	4.0 ± 0.18 ^{ns}
SP 3						
Colour	0	4.00 ± 0.0.3	4.5 ± 0.21	4.5 ± 0.13	4.0 ± 0.22	4.0 ± 0.22
	15	4.00 ± 0.21^{ns}	4.2 ± 0.23**	4.0 ± 0.0.31***	4.00 ± 0.31^{ns}	4.00 ± 0.23 ^{ns}
Texture	0	4.0 ± 0.31	4 ± 0.33	3.8 ± 0.32	4.0 ± 0.30	4 ± 0.29
	15	4 ± 0.08 ^{ns}	3.5 ± 0.32**	4.5 ± 0.05***	4.0 ± 0.21 ^{ns}	4.5 ± 0.14***
Crispiness	0	4.00 ± 0.31	3.5 ± 0.36	3.5 ± 0.36	3.50 ± 0.33	4.00 ± 0.30
	15	4.00 ± 0.20^{ns}	4.0 ± 0.28**	4.00 ± 0.36**	4.00 ± 0.31**	4.00 ± 0.22 ^{ns}
Flavour	0	4.0 ± 0.23	4.2 ± 0.23	4.00 ± 0.22	4.5 ± 0.15	4.00 ± 0.19
	15	3.00 ± 0.42***	3.5 ± 0.24***	4.0 ± 0.18 ^{ns}	4.0 ± 0.57***	4.0 ± 0.18 ^{ns}
SP 4						
Colour	0	3.8 ± 0.22	3.5 ± 0.33	3.8 ± 0.27	4.00 ± 0.32	4.00 ± 0.05
	15	4.00 ± 0.27^{ns}	4.20 ± 0.29***	4.00 ± 0.36^{ns}	4.00 ± 0.30^{ns}	4.00 ± 0.18^{ns}
Texture	0	3.5 ± 0.41	3.5 ± 0.30	3.5 ± 0.33	3.8 ± 0.24	3.5 ± 0.28
	15	4.00 ± 0.22**	3.50 ± 0.23 ^{ns}	4.50 ± 0.0***	4.00 ± 0.12*	4.50 ± 0.11***
Crispiness	0	4.0 ± 0.31	3.50 ± 0.32	3.50 ± 0.36	4.0 ± 0.28	4.00 ± 0.30
	15	4.00 ± 0.31 ^{ns}	4.0 ± 0.14***	4.0 ± 0.10***	4.0 ± 0.35 ^{ns}	4.00 ± 0.31 ^{ns}
Flavour	0	3.8 ± 0.23	4.0 ± 0.22	4.00 ± 0.28	4.2 ± 0.23	4.00 ± 0.18
	15	3.00 ± 0.31***	3.50 ± 0.30***	4.0± 0.18 ^{ns}	4.0 ± 0.30**	4.00 ± 0.08 ^{ns}

Values represent mean and standard deviation of sensory scores. The statistical differences are between fresh and stabilized product on application of Students T test. ***: P≤0.001; **: P≤0.01;*: P≤0.05; ns: not significant – P> 0.05.

Table 7: Nutritional composition of Spice variant Gherkin Pickles (per 100g)

Parameters	SP 1	SP2	SP3	SP4
Carbohydrate (g)	4.73 ± 0.028	4.78 ± 0.141	4.38 ± 0.169	4.33 ± 0.028
Protein (g)	1.26 ±0.028	1.44 ± 0.024	1.13 ± 0.106	0.67 ± 0.035
Fat (g)	0.15 ± 0.014	0.26 ± 0.014	0.38 ± 0.017	0.53 ± 0.176
Vitamin C (mg)	4.24 ± 0.021	5.24 ± 0.021	5.19 ± 0.042	5.09 ± 0.127
Calcium (mg)	44.19 ± 0.247	46.71 ± 0.134	45.3 ± 0.707	51.5 ± 0.707
Energy (Kcal)	25.3 ± 0.070	27.2± 0.282	24.99 ± 0.926	24.58 ± 0.671

Values represent mean and standard deviation of sensory scores.

Table 6 shows the comparison between the overall sensory score of the freshly prepared pickles with spices and the same pickles post 15 days of stabilization period. The sensory scores for various sensory characteristics were varying for individual trials and were very much dependent on the ratings given by the panelists. For the spice variant 1, where the pickles were prepared using fresh spices (dill leaves, onion and garlic), the colour difference was non-significant in almost all the trials taken to standardize the product. However, the difference was very much significant for the flavour characteristic of pickles freshly packed and the same pickle after 15 days of stabilization period. This study supported the findings of by Salashiniski *et al*. [17] whose study showed an improvement of flavour of pickled cucumber by the use of spices.

In case of the spice variant 2 (gherkin pickle with dill leaves, onion and garlic in dehydrated form), the same trend recorded for colour as that of SP1, where there was no significant difference observed in the colour of the freshly packed pickle and the stabilized pickle. The difference was significant for the flavour characteristic in the first two trials, but no significant difference noted in the subsequent trials. However, for this variant the difference was significant in many of the trials for the texture and the corresponding crispiness of the pickles when compared between the freshly packed with the pickles after 15 days of stabilization period. Under the spice variant 3 (SP3) and 4 (SP4),the pickles were packed along with cumin seeds, dry pepper, dry chilli, and dehydrated dill leaves, yellow mustard and fresh onion. These are the spices used daily in every Indian household. For both the variants, non-significant difference was found for the sensory attributes colour, flavour and crispiness for the products packed in the 5th. / final trial. However, the only characteristic for which the difference was highly significant between the freshly packed and stabilized product of both the variants, was the texture of the product. This finding did not support the perception of the consumers who usually perceive texture with the 'crispiness' of the product.

Nutritional Profile of the Pickles Post 15 Days of Stabilization Period

Data on the proximate composition of edible portion of cucumber (*Cucumis sativus*) was reported by Gopalan et al (1982) [18]. Similarly, the composition of cucumber pickle by a number of workers, was appraised by Sandhu et. al (1996) [4] in relation to vitamins, sugars, proteins and minerals.

Through this study, an effort was made to understand the nutrition profile of the gherkin pickles, after the stabilization for 15 days period and the data is compiled in Table 7. The carbohydrate content of cucumber is 2.5% as reported by Gopalan *et.al*. [18]. In our study, when cucumber was processed with vinegar and various Indian spices, the carbohydrate content was found to be in the range of 4.33 to 4.78%.

The protein content was lowest (0.67) in the variant 4 where spices in combined forms were used to prepare the pickles. This result supported the study carried out by Alian et al (1979) [19],who reported the protein content of 0.7 in the pasteurized dill cucumber pickle. The total fat content was noted to be low in all four variants and was recorded between 0.15 to 0.53%.The Vitamin C content was highest (5.24mg/100g) in the variant 2 with dehydrated spices and surprisingly lowest in the variant 1 (4.24mg/100g) with the same spices, but in fresh form. This is because of the loss of the Vitamin C during washing and pasteurization of fresh spices, as Vitamin C is a water soluble vitamin and also sensitive to heat treatment.

Koli and Kulkarni (1973) [20] studied the calcium content of fermented cucumber pickles after 15 days of fermentation period and found reduction of calcium content at the end of 15 days. In the present study, almost same level of calcium found in all variants of pickles which was in the range of 44.19 to 51.5mg/ 100g. Sour pickles is low in calories. This statement was very well supported by the present study where all the four variants recorded low energy content of 25.3, 27.2, 24.9 and 24.5 kcal/100g for variants SP1, SP2, SP3 and SP4 respectively.

Summary and Conclusion

Although spices are used in many traditional pickles, their potential usageare not explored in the gherkin pickles. The processing of such gherkin pickles along with traditional spices is simple, less expensive but has huge potentiality to earn revenue in export market. The present study deals with the processing of gherkin pickles with various Indian spices and its impact on the physico-chemical, nutritional and the sensory profile of the pickles. The study shows that, use of various spices enhances the nutritional profile and texture profile of gherkin pickles and is very well accepted among the panelist. Presence of spices in the gherkin pickle did not change the colour of the pickles even after the completion of osmosis process post stabilization period. Though the present study focuses only on gherkin pickles, spices can be very well explored in other vegetables that can be processed and stored for longer time. While Indian spices are famous globally as such, use of these spices in various other food globally consumed, will give an opportunity to earn revenues and strengthen our farmer's economy.

Acknowledgement

The support extended by *M/S Ecovinal International Pvt. Ltd.*- Specialty Food Divisionfor the preparation and pasteurization of pickle variants by furnishing their facility and skilled resources is thoroughly acknowledged by the author.

References

1. Nguyen QV. Pickled and Dried Asian Vegetables. A Report for the Rural Industrial research and Development Corporation. The Horticulture research and advisory station, NSW, Agriculture; 2000, iii-vi.
2. Vishwa M. Horticulture production in India estimated at record 295 million tonnes in 2016-17. Report by Times of India, reported on May 30, 2017; 07.33 PM IST. Available from http://timesofindia.indiatimes.com/india/horticulture-production-in-india-estimated-at-record-295-million-tonnes-in-2016-17/articleshow/58913722.cms.
3. Kapur S. Gherkin: A potential crop for Indian Export Industry. Indian Horticulture, ISSN 0019-4875; 48(1): 42-46.
4. Sandhu KS and Shukla FC. Methods for pickling of cucumber (*cucumis sativus*): A critical appraisal. J Food Sc. Technol. 1996:58-76.
5. Cruess WV. Commercial Fruit and Vegetable Products. New York: Mc-Graw Hill Book Co. Inc; 1958.p.884.
6. Kuwahara Y, Otsuka N, Manabe M. Effect of minerals on texture and pectin components of cucumber pickles. J Japanese Sc Food Sci Technol. 1985;32(10):710-717.
7. Rodrigo M, Alvarruiz A, Villa R, Feria A. Lactic acid controlled fermentation of fresh cucumbers and product quality. Revista de AgroquimiciaY. Technolgia de Alimentos. 1985;25(1):104-116.
8. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products.2nd edn. New Delhi, India: Tata Mc-Graw Hill Publishing Co. Ltd; 2005:206-210.
9. Uthpala TGG, Marapana RAJU, Pathirage AC and Jayawardana SA. Effect of the nutritional composition on the textural quality of two gherkins (Cucumis sativus L.) varieties (Ajax & Vlasset) on brine fermentation. Poster presented in Sri Lanka Association for the Advancement of Science Proceedings of the 72nd Annual Sessions; 2016.
10. Association of Official Agricultural Chemists (A.O.A.C) Official methods of analysis. 12th.edn. Washington DC: Association of Analytical Chemists; 1975.
11. Zhuk VA. Optimising organoleptic evaluation of pickled cucumber. Tovarovedenic. 1991;24:9-12.
12. Lee SY. Microbial Safety of pickled Fruits and Vegetables and Hurdle Technology. Int. J. Food Sci Technol. 2004;4:21-32.
13. Seetaramaiah K, Smith AA, Murali R, Manavalan R. Preservation in Food Products-Review. Int.J Pharmaceutical & Biological Archives.2011; 2(2): 583-599.
14. Kuhlman NG. Sensory and Instrumental Analysis of Pasteurized Dill Pickles Made from Acidified, Bulk Stored Cucumbers. Thesis submitted to North Carolina State University in partial fulfilment of the requirements for the degree of Master of Science in Food Science (2009).
15. Harris CP, Mcfeeter RF and Fleming PH. Fresh cucumber flavor in refrigerated pickles: Comparison of sensory and instrumental analysis. J.Agric. Food Chem. 2002;50:4875-4877.
16. Fleming PH, Kyung KH, Breidt F. Vegetable fermentations. In Biotechnology. 2nd edn. New York: Rehm,H.J.,Reed,G.,Eds.VCH Publishers; 1995:629-661.
17. Salashiniski NA, Yankevich LT, Uspenskaya IG. Method for pickling cucumbers. USSR Patent. 1991; SU 1 658 A1.
18. Gopalan C, Ramsastri BV, Balasubramanian SC. Nutritive Value of Indian Foods. India: National Institute of Nutrition. ICMR. Hyderabad; 1996.p.47.
19. Alian AM, Shaheem AB, Abd-EI-Gaid IO. Changes in nitrogenous constituents and ascorbic acid content of some vegetables as affected by three different pickling methods. Agric Res Rev. 1974;52(3):199-206.
20. Koli PN and Kulkarni PR. Fermentation of cucumbers in brine. Indian food packer. 1973;27(4):13-17.

SUBSCRIPTION FORM

I want to renew/subscribe international class journal **"International Journal of Food, Nutrition & Dietetics"** of Red Flower Publication Pvt. Ltd.

Subscription Rates:
• Institutional: INR5000/USD500

Name and complete address (in capitals): _____

_____

Payment detail:
Online payment link: http://rfppl.co.in/payment.php?mid=15

Cheque/DD: Please send the US dollar check from outside India and INR check from India made payable to 'Red Flower Publication Private Limited'. Drawn on Delhi branch.

Wire transfer/NEFT/RTGS:
Complete Bank Account No. 604320110000467
Beneficiary Name: Red Flower Publication Pvt. Ltd.
Bank & Branch Name: Bank of India; Mayur Vihar
MICR Code: 110013045
Branch Code: 6043
IFSC Code: BKID0006043 (used for RTGS and NEFT transactions)
Swift Code: BKIDINBBDOS

Term and condition for supply of journals
1. Advance payment required by Demand Draft payable to Red Flower Publicaion Pvt. Ltd. payable at Delhi.
2. Cancellation not allowed except for duplicate payment.
3. Agents allowed 10% discount.
4. Claim must be made within six months from issue date.

Mail all orders to
Subscription and Marketing Manager
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II
Mayur Vihar Phase-I
Delhi - 110 091(India)
Phone: 91-11-45796900, 22754205, 22756995, Cell: +91-9821671871
E-mail: sales@rfppl.co.in

Original Article

International Journal of Food, Nutrition and Dietetics
Volume 5 Number 3, September - December 2017
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.5317.4

Hygienic Practices of Food Handlers in India

Baruah Urmimala[1], Gogoi Sukanya[2]

Abstract

The present study has been undertaken to review the "Hygienic Practices of Food Handlers in India". Food Hygiene is concerned with the hygienic practices that prevent food poisoning. The study was conducted to know about the hygienic practices followed by food handlers in India; and secondary data was collected from different journals, books, internet, etc. Results depicted that the levels of personal hygiene of the food handlers in the eating establishments were found to be unsatisfactory. The findings highlight the importance of food hygiene education among the food handlers to incalculate the practices of good personal hygiene among the food handlers.

Keywords: Food Hygiene; Food Handler; Hygienic Practices.

Introduction

Hygiene is a set of practices performed for the preservation of health. Hygiene refers to conditions and practices that help to maintain health and prevent the spread of disease. Whereas in popular culture and parlance it can often mean mere 'cleanliness', hygiene in its fullest and original meaning goes much beyond that to include all circumstances and practices, lifestyle issues, premises and commodities that engender a safe and a healthy environment. Some regular hygienic practices may be considered good habits by a society while the neglect of hygiene can be considered disgusting, disrespectful or even threatening. Food hygiene is concerned with the hygiene practices that prevent food poisoning.

Food hygiene consists of several principles adopted to ensure food safety and to protect food from any chemical, microbiological or other type of contamination that can render it unfit for human consumption, to prevent the spread of communicable diseases associated with food and food processing and also to ensure that consumers of food are not fraudulently treated. It also ensures that food when purchased is of a nature, composition and quality as demanded by the purchasers. Proper food hygiene should ensure that food is handled, stored, prepared and served in such a way and under such conditions so as to prevent, as far as possible, the contamination of the food (WHO, 2011).

A food handler is anyone who handles food or items that may come into contact with food, such as eating and drinking utensils. All food handlers are legally obliged to comply with the health and hygiene requirements set out in the food safety standards. The food safety standards contain requirements that apply only to food handlers. These requirements relate to health and hygiene and have been included to ensure that food handlers take steps to avoid contaminating food.

All consumers have the right to expect safe, hygienically prepared and good quality food. This is the reason that the handling of food requires care to prevent the hazards. Good hygiene practices are the set of requirements to prevent contamination of food in order to provide safe food to the consumers. Food borne illnesses can result from contamination due to improper practices like when there is lack of environmental hygiene and poor sanitation, mixed and inappropriate transportation, poor storage, poor personal hygiene, unsafe source of food.

Author's Affiliation: [1]Assistant Professor [2]Post Graduate Student, Department of Home Science, Lakhimpur Girls' College, Lakhimpur, Assam 787031, India.

Corresponding Author: Gogoi Sukanya, Post Graduate Student, Department of Home Science, Lakhimpur Girls' College, Lakhimpur, Assam 787031, India.
E-mail: urmibaruah17@gmail.com

Recieved on 19.12.2017, **Accepted on** 16.01.2018

In India, varieties of ready to eat foods are available. This generally includes Chinese fast food, Parathas, Puribhaji, Bhature and Kulche apart from lighter snacks like tea, biscuits, mathi etc. This is the major source of income for the vendors and consumers get instant, tasty and cheap food in return. So Street Food Vending in urban areas especially in metropolitan cities has become an integral part of the urban lives and culture. It is also recognized that despite of good taste and easily availability, street food vendors are often poor, uneducated and lack hygiene practices. So, street foods are perceived to be a major public health risk (WHO, 2013).

Therefore, an attempt has been made to review the study entitled "Hygienic Practices of Food Handlers in India" with the following objectives:-

- To know about the hygienic practices followed by food handlers in India.
- To analyze the factors affecting the hygienic practices of food handlers in India.

Materials and Methods

The present study is based mainly on secondary data collected from different journals, books, internet, etc.

Results and Discussions

The findings and discussion pertaining to the study "Hygienic practices of food handlers in India" are discussed as follows:

In Maharashtra, Gupta and Ketkar (1981) conducted a study and reported that 50% of the food handlers were habituated to chewing pan and 40.1% to chewing tobacco. Food handlers who belongs to below poverty line group were found suffering from majority of the morbid conditions like anemia, halitosis, scabies and other skin disease, phrynoderma, tuberculosis, leprosy as compared to those above poverty line. However hypertension, diabetes and dental carries were more common amongst the individuals who were above poverty line. Of the total 160 food handlers, 54 (33.75%) were suffering from some or the other disease. The high level of morbidity in food handlers could probably be due to poor environmental conditions, poor personal hygiene and low socio-economic status.

In Allahabad, Paulson D.S. (1994) conducted a study and reported that outbreaks are generally caused by foods due to poor personal hygiene of the vendors and that have been mishandled or mistreated during preparation or storage. Handling with bare hands may result in cross contamination, hence introduction of microbes on safe food (Food Agriculture Organization, 1997). Personal hygiene of the vendors was observed and it was found that clothes of (46.6%) of the vendors were moderately clean and clothes of (13.4%) of the vendors were dirty, 60% of the vendors had short nails which were not polished. About (40%) of the vendors were chewing tobacco during food handling and (73.3%) of the vendors did not wiped their hands after every serving.

In Maharashtra, despite continuing progress made in food quality and safety, food borne disease outbreaks continue to be reported in the literature. The most frequently identified factors contributing to the outbreaks are contaminated raw foods or ingredients, and poor personal hygiene by persons who handle foods (Report of the Food and Drugs Authority retail food programmes, 2000). The study reveals that maximum number (54.37%) of food handlers were below 30 years of age but unfortunately 3.75% were small children below the age of 10 years.

Mahan V (2001) conducted a study in Maharashtra, and reported that the overall prevalence of intestinal parasite infestation to be 14% whereas in a study by OA Idowu and SA Rowland (2006) 97% of the food vendors were infected with one or more faeco-orally transmissible parasites. Such a high prevalence of intestinal parasites is largely due to poor personal hygiene practices and environmental sanitation, lack of supply of safe water, poverty, ignorance of health-promotion practices, and impoverished health services. Washing of hand with only water after using the toilet was practiced by 81(50.62%) whereas frequency of cutting nails is less or nil in 26.25% of the food handlers.

In Karnataka, the findings are similar to that of Bolton (2004), who reported that most of the food poisoning in restaurants was due to lack of knowledge of food handlers in safety and hygiene aspects. Also the findings revealed a significant relationship between the knowledge and the knowledge of practices on food safety among the food handlers. It also revealed that information booklet was effective in improving knowledge on food safety.

Bhaskar *et al.* (2004) conducted a study in Allahabad and reported that defective personal hygiene can facilitate the transmission of pathogenic bacteria found in environment and on people's hand via food and humans. Hygiene during handling and cooking of street foods was observed. 20% vendors

cooked food in advance of sale and (16.6%) of them cooked food on morning of sale. After preparing their foods they kept them and served them at ambient temperature. Only (23.3%) of the vendors reheat the food. 50% vendors served food in steel plate and glass (26.6%) and some served on leaves (10%) and news paper (13.4%) with bare hands (36.6%).

A study carried out by Chumber *et al.* (2007) in Allahabad and found that unhygienic surroundings like sewage, improper waste disposal system and inadequate water supply attract flies and houseflies which further increase food contamination. About (63.3%) of the vendors prepared their foods in unhygienic conditions given that garbage and dirty waste were close to the stalls. 60% of the vendors threw waste water besides the stall making the environment surrounding quite filthy.

Andargie *et al*. (2008) conducted a study in Maharashtra and found that 11% of the food handlers did not practice hand washing after using the toilet, this shows that there is a need to give more emphasis on personal hygiene, self care, training and related practices of food handlers.

Another study carried out by Rahul, *et al.* (2008) in New Delhi among the food handlers of Moulana Azad Medical College, revealed that after a three month intervention programme using posters and flip charts, there was an improvement in the knowledge of the food handlers in the food handling practices evidenced by increased hand hygiene practices from 23.5% to 65.4%.

Isara AR and Isah EC (2009) conducted a study in Maharashtra, and reported that 59 (36.87%) food handlers were found illiterate in which different markedly, wherein they found 98% of the respondents were having formal education. The lower literacy rate may be due to the fact the majority of food handlers were migrants from states like Madhya Pradesh, Bihar and Uttar Pradesh where the literacy rates are relatively lower.

This was supported by the study conducted by Isara and Isah (2009) in Karnataka, who found that more than half (52.6%) of the employees had poor knowledge in food hygiene and safety and it also reported that the prevalence of food contamination in fast food restaurants was 37.5%.

This finding was supported by the study conducted by Sung and Chang among the food handlers of Korea (2010) whose results showed an increase in knowledge for the food handlers from 49.3% to 66.6% two weeks after a training programme on food safety.

In Karnataka, George *et al.* (2013); revealed that there were no samples with good knowledge on food safety and all the samples belonged to either average or poor knowledge.

A study conducted by Kumar *et al*. (2013) in Allahabad and found that personal hygiene, health and food handling practices were observed which showed that out of 30 vendors chosen for survey, , 80% were in healthy condition and 20% of them were suffering from cold and fever. 73.3% of the vendors continue food preparation during illness. Regarding reasons for hand washing maximum percentage of vendors (33.4%) and (30%) washed hands after using the toilets and handling garbage.

Taraphdar and De (2016) conducted a study in Kolkata and found that 73% of the study population believed that importance of hand washing is removal of dirt while 45% believed it to be prevention of diseases. On the contrary in Karnataka study almost all the respondents (96.7%) stated that hand washing was important for the prevention of diseases and 45.6% stated its importance to maintain cleanliness.

In Assam, Pokhrel and Sharma (2016) carried out a study and found that out of the 100 interviewed vendors, none had undergone any formal training or apprenticeship on food preparation. They claimed to be self-taught by observing others. Systems should be put in place to ensure that food handlers remain aware of all procedures necessary to maintain the safety and suitability of food. Street food vendors are often unlicensed, untrained in food hygiene and sanitation, and work under crude unsanitary conditions (Food Agriculture Organization, 1997). Findings also showed that 68% of the vendors had the habit of reading food labels before buying them. Results showed that vendors prepared the foods either at home or at the stalls. Majority of the foods were pre-prepared from home and cooked in the stalls. While the rest were brought fully cooked and reheated before serving. Observation during the study showed that the vendors prepared their foods in unhygienic conditions. In all the study areas, garbage and dirty waste were conspicuously close to the stalls. Observation couldn't be made on aspects like, whether the vendors washed the fresh foods like carrots, cabbage, coriander leaves, capsicum, etc. before preparation, as they were cooked or chopped from home and brought. 100% of the vendors asserted that they thoroughly wash the vegetables.

This statement however, cannot be entirely trusted. As there was no source of potable water supply available at their areas of operation, water was ferried from homes of the street food vendors. Vendors carried

water to their business premises in containers of different capacities ranging from 5 to 20 liters. This water, however, was not enough for food preparation and dishwashing. Personal hygiene of the vendors was observed while the vendors were preparing, selling and cleaning in their respective stalls. The use of apron, gloves, hairnet was devoid in 92% of the vendors. Long and dirty nails were also a common observation. Coughing, sneezing and touching of hair during handling of food were also not uncommon. All the vendors handled money while serving food and most of them had worn jewellery and other accessories. Another observation which was found common in majority of the vendors was their habit of wiping their hands in a towel after each preparation.

Conclusion

This study reveals areas of improvement which would translate into positive change towards attaining safe street food. Every vendor, helper or food handler should undergo a basic training in food hygiene. The levels of personal hygiene of the food handlers in the eating establishments were found to be unsatisfactory. The cooks and suppliers who handled food were not maintaining a satisfactory personal hygiene, thereby increasing the risk of food contamination considerably. Good personal hygiene is also expected among the cleaning and dish washing staff. Food hygiene can be best promoted by educating the food handlers about personal hygiene.

Good hygiene principles need to be regulated and enforced. There is a need for introduction of standards, development on food safety management system that are suitable for the locality with continuous and intensive workshops for food handlers.

The Food Safety and Standards Authority of India (FSSAI) has been established under the Food Safety and Standards Act, 2006 as a statutory body for laying down science based standards for articles of food and regulating manufacturing, processing, distribution, sale and import of food so as to ensure safe and wholesome food for human consumption. FSSAI also provides good hygiene practices training for good handlers.

The government of India is also given directives to the local authorities including metropolitan assemblies and their districts to actively control and monitor food safety practice of food vendors. The water and food hygiene unit of the environmental health department of the districts is responsible for the health monitoring and certification of food vendors. Continuous sensitization programmes for food handlers and consumers along the food chain of their roles on compliance with food safety requirements. Good hygiene practices which are mostly called prerequisite measures to be available and enforced as the basic requirement for food industries and vendors.

This is to ensure that they follow the required rules for proper hygiene. As street food forms an integral part of our society vendors should be encouraged to participate and train under the different schemes related to food safety and hygiene lunched by the government. This will in turn upgrade the skills of the street food vendors and also contribute to prevent food borne illness. The findings highlight the importance of food hygiene education among food handlers, to inculcate the practices of good personal hygiene.

References

1. George A., Varghese D.M., and Nayak M.G. Effectiveness of an Information booklet on knowledge and practice on food safety among food handlers in restaurants,Manipal, Karnataka State, India; International Journal of Advanced Research. 2013;1(8):767-775.
2. Kumar A., Bala K.L., and Gadi C. Study of Hygienic practices of street food vendors in Allahabad city, India and Determination of Critical control points for safe street food; The Allahabad Farmer. 2013;58 (2).
3. Meenakshi Dutta Mazumdar and Jayashree Sarmah Goswami. Impact of Training of Street Food Vendors on Food Safety and Hygiene Practices in the City of Guwahati, Assam; International Journal of Multidisciplinary Research Review. 2016;1(3);37.
4. Mudey A.D., Kesharwani N., Mudeyn G.A., Goyal R.C., Dawale A.K., and Wagh V.V. Health Status and Personal Hygiene among Food Handlers Working at Food Establishment around a Rural Teaching Hospital in Wardha District of Maharashtra, India; Global Journal of Health Science. 2010;2(2).
5. Pokhrel P., and Sharma D. A study on assessment of food safety knowledge and practices among the street food vendor of urban and semi urban areas of Guwahati, Assam; International Journal of Home Science, 2016;2(2);85-89.
6. Taraphdar P., and De M. A Study on Water Sanitation Hygiene Washing Practices among Mothers of Under 5 Children Attending Tertiary Care Hospital In Kolkata, India; IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 2016;15(7);54-59.

7. Thakur, C.P., Mehra, R., Narula, C., Mahapatra, S. and Kalita, T.J. Food Safety and Hygiene Practices Among Street Food Vendors in Delhi, India; International Journal of Current Research. 2003;1(11):3531-3534.
8. old.fssai.gov.in
9. https ://en.m.wikipedia.org/wiki/Food.
10. http://www.fao.org/docrep.html.
11. https://en.m.wikipedia.org/wiki/Hygiene.
12. http://foodsafetyhelpline.com/need-know-good-hygiene-practices.
13. http://www.foodstandards.gov.au/consumer/safety/faqsafety/pages/foodsafetyfactsheets/charitiesandcommunityorganisationsfactsheets/healthandhygiene.

Instructions to Authors

Submission to the journal must comply with the Guidelines for Authors.

Non-compliant submission will be returned to the author for correction.

To access the online submission system and for the most up-to-date version of the Guide for Authors please visit:

http://www.rfppl.co.in

Technical problems or general questions on publishing with IJFND are supported by Red Flower Publication Pvt. Ltd's Author Support team (http://rfppl.co.in/article_submission_system.php?mid=5#)

Alternatively, please contact the Journal's Editorial Office for further assistance.

Editorial Manager
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II
Mayur Vihar Phase-I
Delhi - 110 091(India)
Phone: 91-11-22754205, 45796900, 22756995, Cell: +91-9821671871
E-mail: author@rfppl.co.in

Review Article

International Journal of Food, Nutrition and Dietetics
Volume 5 Number 3, September - December 2017
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.5317.5

Spirulina: A Contemporary Food Supplement

E. Lakshmi[1], S. Tamilselvi[2], V. Priya[3]

Abstract

India is a country with heterogenic population having diverse food habits. Cost of health care has become a driving force in the shift towards a greater recognition between diet and health care This has spawned a new era of research leading to the use of few natural unprocessed foods like blue-green algae "spirulina" which has a galaxy of nutrients as diet supplements.The purpose of the present review is to compile evidence regarding the health benefits of spirulina. This review reveals that the greatest amount of evidence on health benefits are its effect in preventing anaemia,blood sugar and obesity .Relevant papers were identified from Science Direct, Google Scholar and pubmed by using all combinations of the search terms related to spirulina and health.

Keywords: Spirulina; Blue-Green Algae.

Introduction

Spirulina. is a unique blue green algae that is rich in chlorophyll and many other life-giving nutrients.The name spirulina comes from a Latin word meaning tiny spiral. It is microscopic, spiral - shaped, blue green algae (Figure 1) belonging to the phylum cyanobacteria. This microcospic single celled blue green spiral algae has been living on our planet since the appearance of life on earth. The green color of spirulina is derived from chlorophyll and the blue color is derived from the exotic pigment phycocyanin (7-8%), a potent health-building pigment that helps produce stem cells [1].

Spirulina is a "micro-vegetable" that can provide some of the antioxidants needed. Green and yellow vegetables are important foods for good health. One of the most well known important natural anti -cancer substances is beta carotene. Spinach and kale with their dark green leaves, broccoli, carrots, cantaloupes, squash, papayas and pumpkin all contain this important substance. Spirulina is very rich in beta-carotene and the antioxidant zeaxanthin, the most important antioxidant for vision [2].

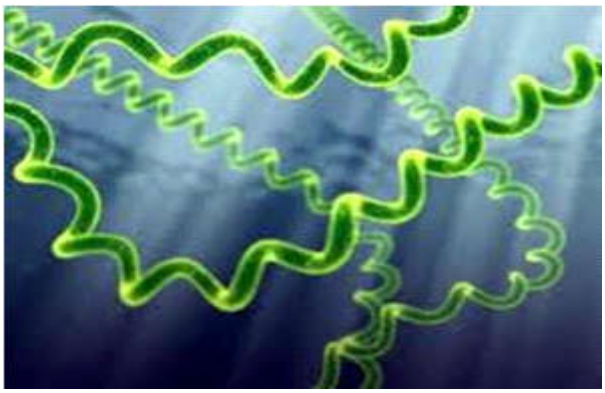

Fig. 1a: Spirulina

Fig. 1b: Spirulina products

Author's Affiliation: [1]Head, Department of Nutrition [2,3]Assisstant Professor, Dept. of Nursing, SRM college of Nursing, SRM University, Kattankulathur, Chennai, Tamil Nadu 603203, India.

Corresponding Author: E. Lakshmi, Head, Department of Nutrition, SRM college of Nursing, SRM University, Kattankulathur, Chennai, Tamil Nadu 603203, India.

E-mail: elakshmi20@gmail.com

Recieved on 28.07.2017, **Accepted on** 17.08.2017

It is one superfood that stands out among the rest and should be taken every single day to ensure good health: Spirulina species has been used as food for centuries by different populations and only rediscovered in recent years. The first documented report on spirulina dates back to the 16th century and is believed to have been a nutritional source for the Aztecs and Meso Americans.The Mayans specifically farmed spirulina as a crop. The Kanembu who live along lake Chad in Africa, were found to be taking spirulina in the form of dihe -"a true filamentous, spiral shaped blue alga from the lake and drying it for food [3].

Nutritional Profile of cyanobacterium,spirulina is amazing. Research suggests that spirulina has a galaxy of nutrients. It is rich in eight essential amino acids, 10 non-essential amino acids, B complex vitamins, zeaxanthin, the antioxidants beta carotene, the essential fatty acid gamma linolenic acid, beneficial probiotic bacteria, dozens of trace minerals and pathogen-targeting proteins. Spirulina also has unmatched ability to boost the immune system and help in detoxificaion of body tissues from various toxins such as arsenic, mercury, radiation, pesticides, cadmium, environmental carcinogens and synthetic food chemicals [4].

Spirulina platensis is a commercial product and one of the important 'super food' with pharmaceutical and nutraceutical properties .Spirulina contains many bioactive compounds with therapeutic activity including antitumor property.It has been stated by NASA that the nutritional value of 1000 kg of fruits and vegetables equals one kg of spirulina.In long-term space missions NASA (CELSS) and European space agency (MELISSA) proposed that spirulina serves as a major source of food and nutrition [5].

Spirulina as a Natural Therapeutic Intervention

Studies suggest that spirulina is also effective in the treatment of anemia. In his book Healing with Whole Foods - Asian Traditions and Modern Nutrition, Paul Pitchford [6] explains how spirulina boosts the production of red blood cells, particularly when taken in combination with vitamin B12.Rich in chlorophyll and phycocyanin, spirulina is also a powerful blood purifier.

Aside from promoting blood cell growth, these two vital nutrients also rejuvenate the existing blood supply. In fact, the structure of chlorophyll is nearly identical to hemoglobin, an important molecule responsible for transporting oxygen to the cells and cleaning the blood.

Few studies have examined that spirulina to ameliorate anemia and immunosenescence in older subjects. In a 12 weeks study by Selmi Carlo et al. [7] enrolled 40 volunteers of both sexes with an age of 50 years or older who had no history of major chronic diseases. participants were told to take spirulina regularly, as well as submit comprehensive dietary questionnaires outlining all other foods they ate during this time. Thirty study participants completed the entire study and the data obtained were analyzed. Upon analysis, the research team found that, throughout the 12-week study period, patients' mean corpuscular hemoglobin, or average hemoglobin mass per red blood cell, increased significantly in both sexes. Both mean corpuscular volume and mean corpuscular hemoglobin concentration increased in male participants as well, but older women were found to derive health benefits from spirulina more quickly compared to men.similar studies were carried by UliyarV.M et al [8].

In one of the earliest studies, Bhat VB and Madyastha KM. [9] reported that spirulina provides an adequate amount of a spectrum of carotenoid pigments, especially beta carotene (associated with cancer prevention) and zeaxanthin (associated with prevention of age-related macular degeneration (AMD). In this respect spirulina is a "micro-vegetable" that can provide some of the antioxidants needed. Many studies have also revealed that antioxidants like the carotenoids in fruits, vegetables, and spirulina have a synergistic effect.

Specifically, there is evidence suggesting that spirulina helps in lowering the serum glucose level. Takai et al [10] found a water-soluble fraction of spirulina to be effective in lowering the serum glucose level at fasting while the water-insoluble fraction suppressed glucose level at glucose loading.

Similar results were found in other studies. In a human clinical study involving 15 diabetics, a significant decrease in the fasting blood sugar level of patients was observed after 21 days of 2 g/day spirulina supplementation. In a double-blind-crossover study versus placebo Becker et al [11] found that a supplementary diet of 2.8 g of spirulina 3 times d-1 over 4 weeks resulted in a statistically significant reduction of body weight in obese outpatients.

A study was planned by Mani UV. et al [12] to observe the long-term effect of spirulina tablet supplementation (2 g/ day) on blood sugar levels, serum lipid profile and glycated serum protein levels of 15 non-insulin dependent diabetes mellitus (NIDDM) patients. Blood analysis was done at baseline, 1 month, and 2 months interval and during

the study period the patients were advised not to change their life style, dietary pattern and drugs.

Supplementation for a period of 2 months resulted in a significant reduction of blood sugar levels and glycated serum protein levels, thus confirming the hypoglycemic effect of spirulina. A significant reduction was observed in triglycerides, total cholesterol and free fatty acid levels. Appreciable reduction was noticed in LDL-C, VLDL-C and HDL-C/ LDL-C ratio.

It was concluded that spray dried spirulina tablets ,rich in gamma linolenic acid, antioxidants, amino acid pattern, fatty acid profile and superoxide dismutase helps in reducing hyperglycemia and shifts the metabolism of lipids towards a favorable side thereby helping in the control of diabetes.

Hirahashi T et al [13] identified the molecular mechanism of the human immune potentiating capacity of Spirulina by analyzing blood cells of volunteers with pre and post oral administration of hot water extract of Spirulina. Some interesting findings reported from the study are ;

1. NK(Natural killer cells that control several types of tumors and microbial infections)functions represented by IFN gamma (IFNã, or type II *interferon*, is a cytokine that is critical for innate and adaptive immunity against viral, some bacterial and protozoal infections)production and cytolysis were enhanced after administration of Spirulina in >50% subjects.
2. IFN gamma was produced in an IL-12/IL-18-dependent fashion.These observations indicated that in humans Spirulina acts directly on myeloid lineages and either directly or indirectly on NK cells. The presence of co-operative IL-12 and IL-18 is critically important for NK-mediated IFN gamma production.

Few studies have examined the in vitro culture of Spirulina with human peripheral blood mononuclear cells (PBMCs) modulating the production of cytokines. Mao TK et al [14] evaluated the spirulina-based dietary supplement (Earthrise Nutritionals, Inc., Irvine, CA) on patients with allergic rhinitis by assessing the production of cytokines [interleukin (IL)-4, interferon (IFN)-gamma, and IL-2] critical in regulating immunoglobulin E-mediated allergy.

In a randomized double-blinded crossover study versus placebo, allergic individuals were fed daily with either placebo or Spirulina, at 1,000 mg or 2,000 mg, for 12 weeks. PBMCs (peripheral blood mononuclear cells) isolated before and after the spirulina feeding were stimulated with phytohem-agglutinin (PHA) prior to determining the levels of cytokine from cell culture supernatants. These results indicate that spirulina can modulate the Th profile in patients with allergic rhinitis by suppressing the differentiation of Th2 cells mediated, in part, by inhibiting the production of IL-4. This is was the first human feeding study that demonstrates the protective effects of spirulina towards allergic rhinitis.

A. Ramamoorthy and S. Premakumari [15] found the hypercholesterolemic effect of spirulina. Thirty ischaemic heart disease patients without any complications with blood cholesterol levels above 250mg/dl were selected for the study and divided into three groups of 10 each for supplementation of spirulina. Subjects in groups A and B received 2g and 4g spirulina per day, respectively for three months. Group C served as control. The study has revealed that spirulina plays a key role in weight reduction, lowering the blood cholesterol levels and improving the lipid profile of patients.

A study was planned by Uma M.Iyer et al[16] to develop recipes supplementing spray-dried spirulina at three different levels (1 g, 2.5 g, and 5 g)and to rank them according to the degree of acceptance.The recipes were

- Different types of parathas with curd
- Different types of vegetables with chapati
- Different types of rice with curd
- Snack

It was found that all the 22 Indian recipes incorporated with spirulina were acceptable with regard to appearance/color, texture, taste/flavor, and overall acceptability at 1 g and 2.5 g levels. Finally it was concluded that:

1. Spray-dried spirulina can be effectively incorporated into various Indian recipes, which would help in the dietary management of diabetes as well as hyperlipidemia as it is low in carbohydrate, has gamma linolenic acid, high in protein, and high in antioxidant content.
2. Owing to its multinutrient property, various recipes that can be supplied in the supplementary feeding programs can be tried out for combating various nutritional disorders such as vitamin A and iron-deficiency anemia.

Production of Spirulina and its Social Acceptance, in India

- Spirulina (Arthrospira) fusiformis was grown in small mud pots to provide food supplements for a family and acceptability of the method as a

family enterprise was evaluated by Jeeji and Seshadri [17].

- Value added extruded product with 5% Spirulina + 95% Wheat flour + 5% Corn flour was developed by Vijayarani et al [18] and sensory parameters like taste, odour, texture, color, appearance were found to be at acceptable level.

Clinical Studies for Combating Malnutrition Using Spirulina in India

- 1 gram of dried spirulina fusiformis was given every day as nutritional supplement to 5000 pre-school children by Seshadri [19] for a period of 6 to 13 months and clinical parameters were evaluated. Based on the survey at the end of the study, 4% reduction in incidence of Bitot's spots was observed.
- 900 mg of spirulina was administrated to 100 girls with age 11 to 13 years for 6 months and significant improvement anthropometric measurements and hemoglobin, serum ferrtin, serum zinc, serum protein and serum albumin levels was observed.by Ramesh et al [20].
- 200 adolescent girls (13-15 years) from Shimla were divided into equal groups by Dewan [21] and one group was given 1 gram spirulina + 40 grams wheat besan ladoo (an Indian recipe) for 6 days a week for two months and other group was given placebo for the same period. The group with spirulina supplementation showed less prevalence of common ailments (paleness of skin, conjunctiva, dental caries, fatigue) when compared with other group Children.

Spirulina contains more natural proteins when compared to other natural foods .The true protein digestibility and the biological activity of spirulina protein calculated by Narasimha et al. [22] is 75.5 and 68 respectively. The Recommended Dietary Allowance (RDA) for protein consumption is 0.8g/ kg body weight and for athletes, RDA ranges from 1.2 to 1.4 g/kg/day [23]. The advantage of spirulina protein is it can withstand up to 67°C without denaturation.

Conclusion

India is a country with heterogenic population having diverse food habits. The present review revealed that spirulina has potential for being a 'wonder food supplement'. One concern is the culture conditions of the spirulina that is being utilized. Blue-green algae harvested in uncontrolled culture conditions may be contaminated with heavy metals that can lead to liver damage, diarrhea, and vomiting. One approach to circumvent this is to grow spirulina in an 'organic' way. Development of various spirulina fortified foods are required to create nutritional awareness and increase the acceptance level in developing countries like india where there are lot of deficiency disorders in the population. Considerable potential exists for spirulina to be used as a food supplement,in therapeutic management of various disorders.

Key Messages

Spirulina is a boon to man- kind. It can be used as a food supplement, in day–to-day life and therapeutic management of various disorders in a better and processed form in receipes and food supplements.

References

1. Kulshreshtha A, Zacharia J, Jarouliya U, Bhadauriya P, Prasad GBKS,Bisen PS. Spirulina in Health Care Management .Current Pharm Biotechnol. 2008;9 (5):400–405.
2. Ranjani R. Anticancer properties of blue green algae spirulina platensis–a review.International Journal of Medicine and Pharmaceutical Sciences. 2013;3(4): 159-168.
3. Cifferi O. Spirulina as a micro organism. Microbiol Rev. 1983;47(4):551-578.
4. Carolin JR, Mary JR. Mineral profile of edible algae Spirulina platensis Int.J.Curr.Microbiol.App.Sci. 2015;4(1):478-483.
5. Cornet JF, Dubertret G. The cyanobacterium Spirulina in the photosyn-thetic compartment of the MELISSA artificial ecosystem. Workshop on artificial ecological systems. 1990 October 24–26; Marseille, France: DARA-CNES.
6. Paul Pitchford, Healing With Whole Foods: Asian Traditions and Modern Nutrition,North Atlantic Books; November 5th 2002; Third Edition,ISBN 155643430.
7. Selmi C, Leung PS, Fischer L, German B, Yang CY, Kenny TP.et al. The effects of Spirulina on anemia and immune function in senior citizens. Cellular and Molecular Immunology. 2011 May;8(3):248-254.
8. UliyarV.Mani, Uma M.Iyer, Swati A. Dhruv, Indirani U Therapeutic Utilityof Spirulina. M. E. Gershwin, Amha .Belay editors..Spirulina in Human Nutrition and Health.CRC Press. October 8, 2007;71-72.
9. Bhat VB, Madyastha KM. C-phycocyanin: a potent

peroxyl radical scavenger in vivo and in vitro. Biochem Biophys Res Commun. 2000;18:275(1) :20-5.

10. Takai Y, Hossayamada Y, Kato T. Effect of water soluble and water insoluble fractions of Spirulina over serum lipids and glucose resistance of rats.J Jpn Soc Nutr Food Sci. 1991;44:273:277.
11. Becker EW, Jakover B, Luft D, Schmuelling RM. Clinical and biochemical evaluations of the alga Spirulina with regard to its application in the treatment of obesity: a double-blind cross-over study. Nutr Rep Int. 1986;33:565-574.
12. Mani UV, Desai S, Iyer U. Studies on the long-term effect of Spirulina supplementation on serum lipid profile and glycated proteins in NIDDM patients. Journal of Nutraceuticals, Functional and Medical Foods. 2000;2(3):25–32.
13. Hirahashi T, Matsumoto M, Hazeki K, Saeki Y, Ui M, Seya T. Activation of the human innate immune system by Spirulina: augmentation of interferon production and NK cytotoxicity by oral administration of hot water extract of Spirulina platensis International Immuno pharmacology. 2002;2(4):423–434).
14. Mao TK, Van de Water J, Gershwin ME. Effects of a Spirulina-based dietary supplement on cytokine production from allergic rhinitis patients. J Med Food. 2005;8(1):27-30.
15. Ramamoorthy A, Premakumari S. Effect of supplementation of Spirulina on Hypercholes-terolemic Patients. Journal of Food Science and Technology.1996;33(2):124-127.
16. Uma M. Iyer, S, Dhruv A, Indirani UM. Spirulina and Its Therapeutic Implications as a Food Product. M.E. Gershwin, Amha Belaye. Spirulina in Human Nutrition and Health.CRC Press. October 8, 2007;51-55.
17. Jeeji Bai N, Seshadri CV. Small scale culture of Spirulina (Arthrospira) as a food supplement for rural households - Technology development and transfer. Algological Studies/Archiv für Hydrobiologie, 1988;50-53:565-572.
18. Vijayarani D, Ponnalaghu S, Rajathivya J. Development of Value Added Extruded Product Using Spirulina. International Journal of Health Sciences and Research. 2012;2(4):42-47.
19. Seshadri CV. "Large scale nutritional supplementation with Spirulina alga." All India Coordinated Project on Spirulina. Shri Amm Murugappa Chettiar Research Center (MCRC) Madras, India. 1993.
20. Ramesh S, Manivasgam M, Sethupathy S, Shantha K. Effect of Spirulina on Anthropometry and Bio-Chemical Parameters in School Children. IOSR Journal of Dental and Medical Sciences. 2013;7(5): 11-15.
21. Dewan A. Impact of Spirulina as a Nutritional Supplement on the Dietary Intake and Health Status of Adolescent Girls of Shimla. J Res.: THE BEDE ATHENAEUM. 2014; 5(1):26-34.
22. Narasimha DLR, Venkataraman GS, Duggal SK, Eggum BO. Nutritional quality of the blue-green alga Spirulina platensis geitler. J. Sci. Food Agric. 1982; 33:456–460.
23. Otten J, Hellwig J, Meyers L, eds. Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC:National Academies Press; 2006.

Guidelines for Authors

Manuscripts must be prepared in accordance with "Uniform requirements for Manuscripts submitted to Biomedical Journal" developed by international committee of medical Journal Editors.

Types of Manuscripts and Limits

Original articles: Up to 3000 words excluding references and abstract and up to 10 references.

Review articles: Up to 2500 words excluding references and abstract and up to 10 references.

Case reports: Up to 1000 words excluding references and abstract and up to 10 references.

Online Submission of the Manuscripts

Articles can also be submitted online from http://rfppl.co.in/customer_index.php.

I) First Page File: Prepare the title page, covering letter, acknowledgement, etc. using a word processor program. All information which can reveal your identity should be here. use text/rtf/doc/PDF files. Do not zip the files.

2) Article file: The main text of the article, beginning from Abstract till References (including tables) should be in this file. Do not include any information (such as acknowledgement, your name in page headers, etc.) in this file. Use text/rtf/doc/PDF files. Do not zip the files. Limit the file size to 400 Kb. Do not incorporate images in the file. If file size is large, graphs can be submitted as images separately without incorporating them in the article file to reduce the size of the file.

3) Images: Submit good quality color images. Each image should be less than 100 Kb in size. Size of the image can be reduced by decreasing the actual height and width of the images (keep up to 400 pixels or 3 inches). All image formats (jpeg, tiff, gif, bmp, png, eps etc.) are acceptable; jpeg is most suitable.

Legends: Legends for the figures/images should be included at the end of the article file.

If the manuscript is submitted online, the contributors' form and copyright transfer form has to be submitted in original with the signatures of all the contributors within two weeks from submission. Hard copies of the images (3 sets), for articles submitted online, should be sent to the journal office at the time of submission of a revised manuscript. Editorial office: Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi – 110 091, India, Phone: 91-11-22754205, 45796900, 22756995. E-mail: author@rfppl.co.in. Submission page: http://rfppl.co.in/article_submission_system.php?mid=5.

Preparation of the Manuscript

The text of observational and experimental articles should be divided into sections with the headings: Introduction, Methods, Results, Discussion, References, Tables, Figures, Figure legends, and Acknowledgment. Do not make subheadings in these sections.

Title Page

The title page should carry

1) Type of manuscript (e.g. Original article, Review article, Case Report)
2) The title of the article, should be concise and informative;
3) Running title or short title not more than 50 characters;
4) The name by which each contributor is known (Last name, First name and initials of middle name), with his or her highest academic degree(s) and institutional affiliation;
5) The name of the department(s) and institution(s) to which the work should be attributed;
6) The name, address, phone numbers, facsimile numbers and e-mail address of the contributor responsible for correspondence about the manuscript; should be mentoined.
7) The total number of pages, total number of photographs and word counts separately for abstract and for the text (excluding the references and abstract);
8) Source(s) of support in the form of grants, equipment, drugs, or all of these;
9) Acknowledgement, if any; and
l0) If the manuscript was presented as part at a meeting, the organization, place, and exact date on which it was read.

Abstract Page

The second page should carry the full title of the manuscript and an abstract (of no more than 150 words for case reports, brief reports and 250 words for original articles). The abstract should be structured and state the Context (Background), Aims, Settings and Design, Methods and Materials, Statistical analysis used, Results and Conclusions. Below the abstract should provide 3 to 10 keywords.

Introduction

State the background of the study and purpose of the study and summarize the rationale for the study or observation.

Methods

The methods section should include only information that was available at the time the plan or protocol for the study was written such as study approach, design, type of sample, sample size, sampling technique, setting of the study, description of data collection tools and methods; all information obtained during the conduct of the study belongs in the Results section.

Reports of randomized clinical trials should be based on the CONSORT Statement (http://www.consort-statement. org). When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000 (available at http://www.wma.net/e/policy/l 7-c_e.html).

Results

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations. Extra or supplementary materials and technical details can be placed in an appendix where it will be accessible but will not interrupt the flow of the text; alternatively, it can be published only in the electronic version of the journal.

Discussion

Include summary of key findings (primary outcome measures, secondary outcome measures, results as they relate to a prior hypothesis); Strengths and limitations of the study (study question, study design, data collection, analysis and interpretation); Interpretation and implications in the context of the totality of evidence (is there a systematic review to refer to, if not, could one be reasonably done here and now?, What this study adds to the available evidence, effects on patient care and health policy, possible mechanisms)? Controversies raised by this study; and Future research directions (for this particular research collaboration, underlying mechanisms, clinical research). Do not repeat in detail data or other material given in the Introduction or the Results section.

References

List references in alphabetical order. Each listed reference should be cited in text (not in alphabetic order), and each text citation should be listed in the References section. Identify references in text, tables, and legends by Arabic numerals in square bracket (e.g. [10]). Please refer to ICMJE Guidelines (http://www.nlm.nih.gov/bsd/uniform_requirements.html) for more examples.

Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM,

editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

More information about other reference types is available at www.nlm.nih.gov/bsd/uniform_requirements.html, but observes some minor deviations (no full stop after journal title, no issue or date after volume, etc).

Tables

Tables should be self-explanatory and should not duplicate textual material.

Tables with more than 10 columns and 25 rows are not acceptable.

Table numbers should be in Arabic numerals, consecutively in the order of their first citation in the text and supply a brief title for each.

Explain in footnotes all non-standard abbreviations that are used in each table.

For footnotes use the following symbols, in this sequence: *, ¶, †, ‡‡,

Illustrations (Figures)

Graphics files are welcome if supplied as Tiff, EPS, or PowerPoint files of minimum 1200x1600 pixel size. The minimum line weight for line art is 0.5 point for optimal printing.

When possible, please place symbol legends below the figure instead of to the side.

Original color figures can be printed in color at the editor's and publisher's discretion provided the author agrees to pay.

Type or print out legends (maximum 40 words, excluding the credit line) for illustrations using double spacing, with Arabic numerals corresponding to the illustrations.

Sending a revised manuscript

While submitting a revised manuscript, contributors are requested to include, along with single copy of the final revised manuscript, a photocopy of the revised manuscript with the changes underlined in red and copy of the comments with the point to point clarification to each comment. The manuscript number should be written on each of these documents. If the manuscript is submitted online, the contributors' form and copyright transfer form has to be submitted in original with the signatures of all the contributors within two weeks of submission. Hard copies of images should be sent to the office of the journal. There is no need to send printed manuscript for articles submitted online.

Reprints

Journal provides no free printed reprints, however a author copy is sent to the main author and additional copies are available on payment (ask to the journal office).

Copyrights

The whole of the literary matter in the journal is copyright and cannot be reproduced without the written permission.

Declaration

A declaration should be submitted stating that the manuscript represents valid work and that neither this manuscript nor one with substantially similar content under the present authorship has been published or is being considered for publication elsewhere and the authorship of this article will not be contested by any one whose name (s) is/are not listed here, and that the order of authorship as placed in the manuscript is final and accepted by the co-authors. Declarations should be signed by all the authors in the order in which they are mentioned in the original manuscript. Matters appearing in the Journal are covered by copyright but no objection will be made to their reproduction provided permission is obtained from the Editor prior to publication and due acknowledgment of the source is made.

Abbreviations

Standard abbreviations should be used and be spelt out when first used in the text. Abbreviations should not be used in the title or abstract.

Checklist

- Manuscript Title
- Covering letter: Signed by all contributors
- Previous publication/ presentations mentioned, Source of funding mentioned
- Conflicts of interest disclosed

Authors

- Middle name initials provided.
- Author for correspondence, with e-mail address provided.
- Number of contributors restricted as per the instructions.
- Identity not revealed in paper except title page (e.g.name of the institute in Methods, citing previous study as 'our study')

Presentation and Format

- Double spacing
- Margins 2.5 cm from all four sides
- Title page contains all the desired information. Running title provided (not more than 50 characters)
- Abstract page contains the full title of the manuscript
- Abstract provided: Structured abstract provided for an original article.
- Key words provided (three or more)
- Introduction of 75-100 words
- Headings in title case (not ALL CAPITALS). References cited in square brackets
- References according to the journal's instructions

Language and grammar

- Uniformly American English
- Abbreviations spelt out in full for the first time. Numerals from 1 to l0 spelt out
- Numerals at the beginning of the sentence spelt out

Tables and figures

- No repetition of data in tables and graphs and in text.
- Actual numbers from which graphs drawn, provided.
- Figures necessary and of good quality (color)
- Table and figure numbers in Arabic letters (not Roman).
- Labels pasted on back of the photographs (no names written)
- Figure legends provided (not more than 40 words)
- Patients' privacy maintained, (if not permission taken)
- Credit note for borrowed figures/tables provided
- Manuscript provided on a CDROM (with double spacing)

Submitting the Manuscript

- Is the journal editor's contact information current?
- Is the cover letter included with the manuscript? Does the letter:

1. Include the author's postal address, e-mail address, telephone number, and fax number for future correspondence?
2. State that the manuscript is original, not previously published, and not under concurrent consideration elsewhere?
3. Inform the journal editor of the existence of any similar published manuscripts written by the author?
4. Mention any supplemental material you are submitting for the online version of your article. Contributors' Form (to be modified as applicable and one signed copy attached with the manuscript)

Subject Index

Revised Rates for 2018 (Institutional)

Title	Frequency	Rate (Rs): India		Rate ($):ROW	
Community and Public Health Nursing	3	5500	5000	430	391
Dermatology International	2	5500	5000	430	391
Gastroenterology International	2	6000	5500	469	430
Indian Journal of Agriculture Business	2	5500	5000	413	375
Indian Journal of Anatomy	4	8500	8000	664	625
Indian Journal of Ancient Medicine and Yoga	4	8000	7500	625	586
Indian Journal of Anesthesia and Analgesia	4	7500	7000	586	547
Indian Journal of Biology	2	5500	5000	430	391
Indian Journal of Cancer Education and Research	2	9000	8500	703	664
Indian Journal of Communicable Diseases	2	8500	8000	664	625
Indian Journal of Dental Education	4	5500	5000	430	391
Indian Journal of Forensic Medicine and Pathology	4	16000	15500	1250	1211
Indian Journal of Emergency Medicine	2	12500	12000	977	938
Indian Journal of Forensic Odontology	2	5500	5000	430	391
Indian Journal of Hospital Administration	2	7000	6500	547	508
Indian Journal of Hospital Infection	2	12500	12000	938	901
Indian Journal of Law and Human Behavior	2	6000	5500	469	430
Indian Journal of Library and Information Science	3	9500	9000	742	703
Indian Journal of Maternal-Fetal & Neonatal Medicine	2	9500	9000	742	703
Indian Journal of Medical & Health Sciences	2	7000	6500	547	508
Indian Journal of Obstetrics and Gynecology	4	9500	9000	742	703
Indian Journal of Pathology: Research and Practice	4	12000	11500	938	898
Indian Journal of Plant and Soil	2	65500	65000	5117	5078
Indian Journal of Preventive Medicine	2	7000	6500	547	508
Indian Journal of Research in Anthropology	2	12500	12000	977	938
Indian Journal of Surgical Nursing	3	5500	5000	430	391
Indian Journal of Trauma & Emergency Pediatrics	4	9500	9000	742	703
Indian Journal of Waste Management	2	9500	8500	742	664
International Journal of Food, Nutrition & Dietetics	3	5500	5000	430	391
International Journal of Neurology and Neurosurgery	2	10500	10000	820	781
International Journal of Pediatric Nursing	3	5500	5000	430	391
International Journal of Political Science	2	6000	5500	450	413
International Journal of Practical Nursing	3	5500	5000	430	391
International Physiology	2	7500	7000	586	547
Journal of Animal Feed Science and Technology	2	78500	78000	6133	6094
Journal of Cardiovascular Medicine and Surgery	2	10000	9500	781	742
Journal of Forensic Chemistry and Toxicology	2	9500	9000	742	703
Journal of Geriatric Nursing	2	5500	5000	430	391
Journal of Microbiology and Related Research	2	8500	8000	664	625
Journal of Nurse Midwifery and Maternal Health	3	5500	5000	430	391
Journal of Organ Transplantation	2	26400	25900	2063	2023
Journal of Orthopaedic Education	2	5500	5000	430	391
Journal of Pharmaceutical and Medicinal Chemistry	2	16500	16000	1289	1250
Journal of Practical Biochemistry and Biophysics	2	7000	6500	547	508
Journal of Psychiatric Nursing	3	5500	5000	430	391
Journal of Social Welfare and Management	3	7500	7000	586	547
New Indian Journal of Surgery	4	8000	7500	625	586
Ophthalmology and Allied Sciences	2	6000	5500	469	430
Otolaryngology International	2	5500	5000	430	391
Pediatric Education and Research	3	7500	7000	586	547
Physiotherapy and Occupational Therapy Journal	4	9000	8500	703	664
Psychiatry and Mental Health	2	8000	7500	625	586
Urology, Nephrology and Andrology International	2	7500	7000	586	547

Terms of Supply:

1. Agency discount 10%. Issues will be sent directly to the end user, otherwise foreign rates will be charged.
2. All back volumes of all journals are available at current rates.
3. All Journals are available free online with print order within the subscription period.
4. All legal disputes subject to Delhi jurisdiction.
5. Cancellations are not accepted orders once processed.
6. Demand draft / cheque should be issued in favour of "Red Flower Publication Pvt. Ltd." payable at Delhi
7. Full pre-payment is required. It can be done through online (http://rfppl.co.in/subscribe.php?mid=7).
8. No claims will be entertained if not reported within 6 months of the publishing date.
9. Orders and payments are to be sent to our office address as given above.
10. Postage & Handling is included in the subscription rates.
11. Subscription period is accepted on calendar year basis (i.e. Jan to Dec). However orders may be placed any time throughout the year.

Order from
Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091 (India), Tel: 91-11-22754205, 45796900, Fax: 91-11-22754205. E-mail: sales@rfppl.co.in, Website: www.rfppl.co.in

Author Index