Intl. J. Food. Ferment. Technol. 7(1): 175-179, June 2017

DOI: 10.5958/2277-9396.2017.00019.8

RESEARCH PAPER

Nutritional Profiling and Sensory Evaluation of Multigrain Flour Based Indigenous Fermented Food

Shikha Singh*, Anisha Verma and Neeru Bala

Department of Food Nutrition and Public Health, Ethelind College of Home Science, SHUATS, Allahabad, UP, India

*Corresponding author: singh.shikha489@gmail.com

Paper No.: 179 **Received:** 24-02-2017 **Revised:** 17-04-2017 **Accepted:** 11-05-2017

Abstract

Fermented foods are the important components of the diets of many parts of the world since time immemorial as it increase the nutritive value, organoleptic characteristics, decreases the cooking time and enhance the shelf-life. Hence, a study was undertaken with the objective to develop fermented food (*Idli*) using multigrain flour mixture and to assess its organoleptic and nutritional properties. Standard recipe (*Idli*) served as a Control (T_0). Along with control; four variations of *Idli* were prepared by replacing rice with different ratio of multigrain flour mixture which was referred to as T_1, T_2, T_3 and T_4, respectively. They were tested for different sensory attributes. Proximate analysis was used to determine the nutritional composition of *Idli.* Appropriate statistical technique was adopted for the analysis. The result revealed that the T_2 (8.30±0.14) was found to be the most acceptable with regards to its overall acceptability followed by T_1(8.22±0.81), T_0(8.11±0.29), T_3 (7.44±0.54) and T_4 (6.66±0.81), respectively. Nutrients content was significantly increased in treatments as compared to control. Thus it can be concluded that value added fermented multigrain product has good organoleptic and nutritional quality.

Keywords: Fermented foods, shelf-life, multigrain flour, organoleptic, nutritional properties

Fermentation is regarded as one of the oldest technique of food preservation and processing. Use of microbes for preparation of food products were well-known for thousands of years and globally, a wide range of fermented foods and beverages contributed significantly to the diets of many people. In traditional fermented food preparations, microbes are used to prepare and preserve food products, adding to their nutritive value, the flavour and other sensory quality attributes (Achi, 2005). The requirement of fermentation is fuelled attributing to the production of organic acids, nutritional enrichment, reduction of endogenous toxins and reduction in duration of cooking (Sekar and Kandavel, 2002). These processes are characterized by their limited need for energy input, allowing microbial fermentations to proceed without external heat sources.

Idli is a traditional naturally fermented steamed product with a soft and spongy texture which is highly popular and widely consumed as a food item in India (Agarwal *et al*., 2000). It makes an important contribution to the diet as a source of protein, calories and vitamins, especially B-complex vitamins, compared to the raw unfermented ingredients (Srilakshmi, 2003). It is a favourite breakfast food in south India with spongy texture, attractive appearance, appetizing taste and flavour to get with its easy digestibility and good nutritive value contribute to its increasing popularity in all parts of India and also in other countries (Manay and Shadaksharaswamy, 2001).

The soybean (*Glycine max*) has good quantity of isoflavones, genistein and daidzein, (phytoestrogen)

which act as a hypocholesterolemic. This legume is a native of East Asia, which is widely grown and has numerous health benefits (Ridges *et al.,* 2001). Barley (*Hordeum vulgare* L.), contains β – glucan which reduces the serum cholesterol. It belongs to the family of grass and one of the first cultivated and widely grown cerealgrains (Shimizu *et al.,* 2008). Flaxseed (*Linum usitatissimum*) contains significant quantities of dietary fiber as well as high concentrations of linolenic acids (omega-3) and lignins. Sesame seed contains good amount of manganese, calcium, copper, iron, phosphorus, vitamin B_1, zinc and dietary fiber and also good quantity of water-soluble antioxidants. Traditionally, curry leaves (*Murraya koenigii* Linn) was used as antiemetic, antidiarrhoeal and blood purifier. It was found to be a potent antioxidant, antidiabetic, antibacterial, antihypertensive and cytotoxic.

The present study was designed to utilize soy flour, sesame seed, whole wheat flour, flaxseed, barley and carrot to develop a low fat and nutrient rich traditionally fermented food which acts as an important functional food in food industries as well as to evaluate the feasibility of substituting rice *Idli* with other cheap and healthy plant based food materials to enhance its organoleptic and nutritional qualities. The results obtained are described here.

MATERIALS AND METHODS

The present investigation was carried out in the Food and Nutrition Research Laboratory of the Department of Food Nutrition and Public Health, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad, U.P.

Raw materials

All Basic ingredients for preparation were purchased from the local market of Allahabad.

Preparation of *Idli*

Nutritious fermented food (*Idli*) was developed by using wheat flour, Soy flour, Flaxseed, Barley flour, gingelly seed and curry leaves powder. The basic recipes were standardized and served as control (T_0). Along with the control T_0, on the basis of acceptability rice and black gram *dhal* mix was replaced by other flour mixture and was referred as to T_1, T_2, T_3 and T_4, respectively. The prepared of *Idli* was served to panel of five experienced members for the organoleptic analysis. Panel members were asked to rate the product for various sensory attributes (colour and appearance, body and texture, taste and flavour and overall acceptability on the help of Nine Points Hedonic Scale (Srilakshmi, 2007).

Treatments and Replications of Developed fermented food

The basic recipes were standardized and served as a control (T_0). Each product was prepared in triplicate. The combination of different ingredients used for the preparation of different treatment were as follows:

T_0: 25 percent Black Gram Dhal + 75 percent Rice (Mix)

T_1: 40 percent Mix + 30 percent Soybean flour + 5 percent Flaxseed flour + 10 percent Barley flour + 10 percent Gingelly seed powder + 5 percent Curry leaves

T_2: 30 percent Mix + 35 percent Soybean flour + 10 percent Flaxseed flour + 10 percent Barley flour+ 10 percent Gingelly seed powder + 5 percent Curry leaves

T_3: 20 percent Mix + 40 percent Soybean flour + 15 percent Flaxseed flour + 10 percent Barley flour + 10 percent Gingelly seed powder + 5 percent Curry leaves

T_4: 10 percent Mix + 45 percent Soybean flour + 20 percent Flaxseed flour+ 10 percent Barley flour + 10 percent Gingelly seed powder + 5 percent Curry leaves

Analysis

The nutritional composition (energy protein, fat, carbohydrate, calcium and iron) of fermented food was carried by using standard procedure described by AOAC (2005). The soxhlet method was used for total fat determination using ether for oil extraction. Protein content was determined by Micro Kjeldahl

method and Carbohydrate was calculated by difference method and energy was calculated. Calcium estimation was done by potassium permanganate titration and iron estimation was done by AAS (Atomic Absorption Spectroscopy).

Statistical analysis

The data obtained from sensory evaluation were statistically analysed by using ANOVA and t test (Banerjee, 2013).

RESULTS AND DISCUSSION

Organoleptic analysis of developed fermented food

The mean scores of *Idli* in relation to various sensory attributes (colour and appearance, body and texture, taste and flavour and overall acceptability) are shown in Table 1.

Table 1: Average sensory score of different sensory attributes of *idli*

Sensory Attributes	Colour and Appearance	Body and Texture	Taste and Flavour	Overall Acceptability
T_0(M ± SE)	8.33±0.55	8.0±0.28	8.0±0.29	8.11±0.29
T_1(M ± SE)	8.66±0.45	7.0±0.00	9.0±0.00	8.22±0.81
T_2(M ± SE)	8.0±0.00	7.9±0.99	9.0±0.24	8.30 ± 0.14
T_3(M ± SE)	7.33±0.24	7.0±0.00	8.0±0.00	7.44±0.54
T_4(M ± SE)	6.0±0.00	5.33±0.28	7.0 ±0.45	6.66±0.81
F_{cal} (5%)	18.93	20.93	17.73	8.03
CD (5%)	0.36	0.34	0.24	0.38

M ± SE =Mean ± standard error, F_{tab} = 3.84, *Significant difference

For colour and appearance T_1 (8.66) has obtained the highest score followed by T_0(8.33), T_2 (8.0), T_3 (7.33) and T_4 (6.0) respectively. A significant difference between treatments regarding the colour and appearance was observed which indicates that the addition of different proportions of soybean flour and flaxseed powder affects the colour and appearance of the prepared products, the colour and appearance becomes darker as the amount of incorporation increases. Similarly, T_0 (8.0) had the highest score for body and texture followed by T_2(7.9), T_1 (7.0),T_3 (7.0) and T_4 (5.33) respectively.

There was significant difference between the body and texture of control and treatments which indicates that the addition of different proportions of soybean and flaxseed affects the body and texture of the prepared products. The body and texture becomes softer as the amount of incorporation increases. The highest score for taste and flavour was awarded to T_1(9.0) and T_2(9.0) followed by T_0 (8.0), T_3 (8.0) and T_4 (7.0), respectively. The taste and flavor score increased till T_3 after that the score decreased as the amount of soybean flour and flaxseed powder increased. The mean score for overall acceptability was the highest in T_2 (8.30) followed by T_1(8.22), T_0 (8.11), T_3 (7.44) and T_4 (6.66) respectively. Thus, it is clearly shown that the average sensory scores of T_2 was liked very much by the panel of judges followed by T_1, T_3, T_0 and T_4, respectively. There was a significant difference between the control and different treatments regarding the overall acceptability of multigrain fermented *idli* as the calculated value of F is greater than the tabulated value of F at 5% probability level. This revealed that the addition of different proportions of soybean flour and flaxseed powder affect the overall acceptability of the prepared products. It is therefore, concluded that the average score for various sensory attributes of *Idli* differed significantly, which may be ascribed to different ratios of soybean flour and flaxseed powder in *Idli.* Similar study was conducted which shows that incorporation of soybean at 20 percent was the most acceptable (Dhanashree *et al.,* 2015). According to the Khatoon *et al.,* (2011) *idli* prepared with 4 percent incorporation of dehydrated curry leaves obtained highest score for taste and flavor (8.52).

Nutritional composition of fermented *idli*

The average nutrient content in treatments and control of *Idli*/ 100 gm was shown in Table 2. The result revealed that highest energy was found T_4 (763 Kcal) followed by T_3 (758 Kcal), T_2 (744 Kcal), T_1 (737 Kcal) and T_0 (682 Kcal) per 100 g respectively. It was observed that the energy content decreases as the

incorporation level of soybean flour and flaxseed powder increases.

Table 2: Average nutrients content in control and different treatments of *Idli* per 100 g

Nutrients	Control	Treatments			
	T_0	T_1	T_2	T_3	T_4
Energy (kcal)	682	737	744	758	763
Carbohydrate (g)	124.8	114.25	110.2	106.5	98.4
Protein (g)	19.8	23.25	24.9	25.5	26.1
Fat(g)	6.3	7.2	7.4	7.5	7.8
Iron (mg)	5.3	6.7	6.8	6.9	7.8
Calcium (mg)	74	92	93.4	94.5	95.2

Protein content was highest in T_4 (26.1 g) followed by T_3 (25.5 g), T_2 (24.9 g), T_1 (23.25 g) and T_0 (19.8 g)per 100 g respectively. The protein content was increases as the incorporation level of soybean flour and flaxseed powder increases. Gopalan *et al.* (1989) reported that the soybean and flaxseed contains good amount of Protein (43.2 g and 20.3 g per 100 g respectively) in comparison to wheat flour. Carbohydrate content was found to be highest in T_0 (124.8 g) followed by T_1 (114.25 g), T_2 (110.2 g), T_3 (106.5 g) and T_4 (98.4 g) per 100 g, respectively. The carbohydrate content decreased as the incorporation level of soybean flour and flaxseed powder increases. Gopalan *et al.* (1989) reported that the carbohydrate content of soybean flour and flaxseed powder (20.9 g and 28.9 g per 100 g) were lower than the wheat flour (69.4 g per 100 g) so as the wheat flour was replaced with soybean flour and flaxseed powder, the carbohydrate content was decreased. Fat content of mixture was highest in T_4 (7.8 g) followed by T_3 (7.5 g), T_2 (7.4 g), T_1 (7.2 g) and T_0 (6.3 g) per 100 g, respectively. It was observed that the fat content increases as the incorporation level of soybean flour and flaxseed powder increases. Gopalan *et al.* (1989) reported that the soybean and flaxseed contains good amount of fat (19.5 g and 37.1 g per 100 g, respectively) in comparison to wheat flour. The calcium and iron content were also highest T_4 (95.2 mg and 7.8 mg) followed by T_3 (94.5 mg and 6.9 mg), T_2 (93.4 mg and 6.8 mg), T_1 (92 mg and 6.7 mg) and T_0 (74 mg and 5.3 mg) per 100 g, respectively. It was observed that the calcium content increases as the incorporation level of soybean flour and flaxseed powder increases. Therefore, it can be concluded that with increase in amount of flaxseed and soybean flour in *Idli* the percentage of nutrients are increased except the carbohydrate.

Comparison of Average nutrients content of control ($\mathbf{T_2}$) and best treatments ($\mathbf{T_2}$) of *Idli* per 100 g is shown in Table 3. It is clear from Table 3 that a significant difference was observed between the energy, carbohydrate, protein and calcium of control and best treatment ($\mathbf{T_2}$) on applying the t test (at 5% level of significance) whereas a non-significant difference was observed for fat and iron content of control and best treatment.

Table 3: Comparison of Average nutrients content in control (T_0) and best treatments (T_2) of *Idli* per 100 g

Nutrients	Control (T_0)	T_2	Difference (t_0-t_1=D)	T (Calculated)	T (Tabulated) $t_{0.05, 2}$	Result
Energy (kcal)	682	744	-62	19.6	4.30	S
Carbohydrate (g)	124.8	110.2	14.6	29.3	4.30	S
Protein (g)	19.8	24.9	-5.1	11.45	4.30	S
Fat (g)	6.3	7.4	-1.1	2.29	4.30	NS
Iron (mg)	5.3	6.8	-1.5	2.34	4.30	NS
Calcium (mg)	74	93.4	-19.4	34.6	4.30	S

CONCLUSION

Among all the treatments T_2 was liked very much by the panel of judges on the basis of sensory attributes followed by T_1, T_3, T_0 and T_4, respectively. The ratio of most acceptable treatments (T_2) was 30:35:10:10:10:5 (Mix, Soybean flour, Flaxseed, Barley flour, Gingelly seed powder and Curry leaves). Nutritional composition was significantly increased by the addition of fermented soy based multigrain flour. The active ingredients from soya bean, flaxseed, barley, sesame seed and curry leaves can be extracted and utilized in various food products including other indigenous and traditional fermented foods also.

REFERENCES

Achi, O.K. 2005. The potential for upgrading traditional fermented foods through biotechnology. *African Journal of Biotechnology*, **4**: 375-380.

Agarwal, R., Rati, E.R., Vijayendra, S.V.N., Varadaraj, M.C. and Prasad, M.S. 2000. Flavour profile of *idli* batter prepared from defined microbial starter cultures. *World Journal of Microbiology and Biotechnology*, **16**: 687-690.

AOAC 2005. Determination of Moisture, Ash, Protein and Fat. Official Methods of Analysis. 18th ed. Association of Official Analytical Chemists, Washington, DC.

Banerjee, P. 2013. Two way ANOVA, In: Introduction to Biostatistics, 4th Ed. (S. Chand Company (P) Ltd., New Delhi), 51-85.

Dhanashree, H., Danga, S.K., Rais, M.S.W., Pate, and Singh, B. 2015. A study on formulation, evaluation and analysis of soya-*idli. International Journal of Current and Academics Review*, **3**: 145-150.

Gopalan, C., Balasubramamian, C.S. and Sastri Rama, V.B. 1989. Nutritive Value of India Foods. IVth edition, (National Institute of Nutrition (NIN), ICAR), 48-61.

Khatoon, J., Verma, A., Chacko, N. and Sheikh, S. 2011. Utilization of dehydrated curry leaves in different food products. *Indian Journal of Natural Products and Resources,* **2**(4): 508-511.

Manay, S.N. and Shadaksharaswamy, M. 2001. Food Facts and Principles, New Age International (P) Limited Publishers, 232-233.

Ridges, L., Sunderland, R., Moerman, K., Meyer, B., Astheimer, L. and Howel, P. 2001. Cholesterol lowering benefits of soy and linseed enriched foods. *Asia Pacific Journal of Clinical Nutrition,* **10**: 204–211.

Sekar, S. and Kandavel, D. 2002. Patenting Microorganisms: towards creating a policy framework. *Journal of Intellectual, Property Rights*, **7**: 211-221.

Shimizu, C., Kihara, M., Aoe, S. and Araki, S. 2008. Effect of high beta-glucan barley on serum cholesterol concentrations and visceral fat area in Japanese men--a randomized, double-blinded, placebo-controlled trial. *Plant Foods and Human Nutrition,* **63**: 21-5.

Srilakshmi, B. 2003. Food Science, Third Edition, (New Age International (P) Limited, Publishers, New Delhi), 17-72.

Srilakshmi, B. 2007. Food science, 4th Ed. New age international (P) Ltd. Publishers, New Delhi. 170-174.