General Impact Factor (GIF): 0.875
Scientific Journal Impact Factor: 1.205

e- ISSN: 2394-5532
p- ISSN: 2394-823X

International Journal of Applied And Pure Science and Agriculture

www.ijapsa.com

SENSORY ATTRIBUTES OF CEREAL AND PULSE BASED 'TEMPEH' CHIPS

Lakshmy P. S[1], Usha V[2], Sharon C. L[3] and Aneena E. R[4]

Department of Home Science, College of Horticulture, Kerala Agricultural University, Thrissur, Kerala, India

Abstract

A variety of indigenous fermented foods exist today; however 'Tempeh' has been one of the most widely accepted and researched mould modified fermented product. In the present study, tempeh types developed using twenty different combinations of cereals and pulses were evaluated for their organoleptic qualities. Tempeh chips were made with fresh tempeh and was assessed for their acceptability. Among the tempeh chips, the overall acceptability score of 8.9 was for T_2 (100 % green gram tempeh) and the lowest overall acceptability score (6.9) was for $T_{16(}$ green gram 50% + cowpea 50%). Tempeh chips prepared with all the combination had a very good acceptability score.

Keywords: Tempeh, Fermentation, Rhizopus oligosporus, Organoleptic evaluation, Overall acceptability

I. INTRODUCTION

Fermentation is one of the household food technologies reviewed extensively as means by which the nutritive value of plant foods could be improved [1]. Fermentation also preserves foods in a wide variety of flavours, aroma and texture. A variety of indigenous fermented foods exist today; however 'Tempeh' has been one of the most widely accepted and researched mould modified fermented product. It is a nutritious oriental fermented food produced by solid state fermentation of soybeans consumed widely in Indonesia.

Tempeh is traditionally made with soybeans only. As tempeh was introduced in Western countries, makers started to experiment with the fermentation of other grains, pulses and cereals all with a unique flavour. As stated by Vaidehi [2], in Indian situation where varieties of pulses are used, tempeh could be prepared with pulses other than soybeans. Hence, in the present study, tempeh types were standardised using different combinations of cereals, pulses and their quality evaluations as well as acceptability studies were conducted.

II. MATERIALS AND METHODS

A. Collection of raw materials

Tempeh was prepared with cereals like rice and wheat, and with legumes like green gram, cowpea and soybean. The cereals and legumes were purchased in one lot from the local market.

Tempeh is an Indonesian fermented food consisting of soybeans partially digested and bound together by mycelium of *Rhizopus*. *Rhizopus oligosporus* is the most frequently isolated organism from natural tempeh samples [3]. Hence, a pure culture of *Rhizopus oligosporus* obtained from Institute of Microbial Technology (IMTECH), Chandigrah was used for tempeh fermentation.

B.Development of tempeh with legumes and cereals

Tempeh was prepared using green gram, cowpea, soybean, rice and wheat in different combinations. The following treatments were tried in two replications.

T_1 Soybean (100%) -control
T_2 Green gram (100%)
T_3 Cowpea (100%)
T_4 Green gram (75%) + soybean (25%)
T_5 Green gram (50%) +soybean (50%)
T_6 Cowpea (75%) + soybean (25%)
T_7 Cowpea (50%) + soybean (50%)
T_8 Green gram (75%) + rice (25%)
T_9 Green gram (50%) + rice (50%)
T_{10} Cowpea (75%) + rice (25%)
T_{11} Cowpea (50%) + rice (50%)
T_{12} Green gram (75%) + wheat (25%)
T_{13} Green gram (50%) + wheat (50%)
T_{14} Cowpea (75%) + wheat (25%)
T_{15} Cowpea (50%) + wheat (50%)
T_{16} Green gram (50%) + cowpea (50%)
T_{17} Soybean (75%) + rice (25%)
T_{18} Soybean (50%) + rice (50%)
T_{19} Soybean (75%) + wheat (25%)
T_{20} Soybean (50%) + wheat (50%)

Selected legumes were cleaned, washed, and boiled for 30 minutes, just making it soft. This was again washed and soaked overnight (12 hours). The legumes were dehulled by floatation in water and were surface dried. In treatments with cereals, wheat was washed and boiled separately for 30 minutes, drained and surface dried and was mixed with the surface dried legumes. In treatments with rice, raw rice was washed and boiled for 5 minutes, drained, surface dried and mixed with the treated surface dried legumes. The substrates were then mixed with vinegar to adjust the pH to 4.5 (100 ml of vinegar for 1 kg of substrate). This substrate (1 kg) was inoculated with two grams of tempeh starter and mixed well. This was then packed in perforated polythene pouches by pressing them flat to a thickness of three centimeter and was sealed. Packed pouches were incubated at 32^0C-36^0C for 48 hours, during which the tempeh fermentation took place, after which the mycelium appeared to be more or less uniformly distributed throughout to form a firm cake with a good flavour.

C. Acceptability of chips prepared with fresh tempeh

In Indonesia, tempeh is used as a meat substitute. Tempeh cakes are cut and added to stir fries and vegetable dishes. Tempeh has a tender chewy consistency that makes it an excellent meat substitute. Hence, in the present study, tempeh chips were prepared for evaluating the organoleptic qualities of fresh tempeh types. Fresh tempeh types were cut to thin uniform slices (4x1 cm) and fried in coconut oil with the addition of salt to prepare tempeh chips. A series of acceptability trials were carried out using simple triangle test at the laboratory level and selected a panel of ten judges between the age group of 18-35 years as suggested by [4]. Score cards were prepared based on a nine point hedonic scale for the organoleptic evaluation of tempeh chips.

III.RESULTS AND DISCUSSION

From fresh tempeh types, tempeh chips were prepared for evaluating the organoleptic qualities. All the twenty tempeh types with different combinations of pulses and cereals were evaluated for their acceptability.

Organoleptic qualities of tempeh chips

Tempeh chips were prepared with the twenty different combinations of fresh tempeh including the control (T_1) and each was evaluated for their organoleptic qualities such as appearance, colour, flavour, texture, taste and overall acceptability by a selected panel of ten judges using a nine point hedonic scale. Mean score obtained for the organoleptic qualities of tempeh chips are presented in Table 1.

Table 1. Mean score for the organoleptic qualities of tempeh chips

Treatments	Appearance	Colour	Flavour	Texture	Taste	Overall Acceptability
T_1	8.9 (17.22)	8.9 (16.83)	7.8 (10.28)	8.4 (15.17)	7.4 (7.33)	8.3 (15.39)
T_2	9.0 (18.11)	9.0 (17.72)	9.0 (18.44)	8.9 (17.83)	8.8 (17.22)	8.9 (19.94)
T_3	8.1(10.78)	7.8 (7.89)	8.7 (17.11)	7.3 (7.83)	8.5 (16.11)	8.1 (12.89)
T_4	7.5 (6.39)	8.0 (9.44)	8.7 (17.11)	9.0 (18.39)	8.4 (15.17)	8.4 (17.39)
T_5	7.5 (6.39)	7.8 (7.89)	7.4 (7.56)	8.2 (13.94)	7.6 (10.00)	7.6 (7.17)
T_6	8.7 (7.22)	7.6 (6.22)	7.4 (7.56)	7.5 (8.78)	7.2 (5.67)	7.5 (4.39)
T_7	8.6 (15.44)	8.7 (15.06)	7.6 (8.44)	8.8 (17.33)	8.0 (12.44)	8.5 (17.22)
T_8	8.5 (15.06)	8.6 (14.17)	8.4 (14.83)	8.0 (12.39)	8.0 (12.44)	8.3 (15.39)
T_9	7.5 (6.39)	7.8 (7.89)	7.8 (10.28)	8.4 (14.39)	8.4 (15.17)	8.1(12.78)
T_{10}	7.7 (8.17)	7.7 (7.83)	7.7 (9.56)	7.1 (6.56)	8.2 (13.06)	7.7 (9.06)
T_{11}	7.5 (6.39)	7.2 (3.83)	8.3 (14.17)	7.3 (7.83)	8.7 (16.67)	7.8 (9.50)
T_{12}	7.5 (6.39)	7.8 (7.89)	7.9 (10.89)	7.7 (10.44)	7.5 (8.11)	7.7 (9.06)
T_{13}	7.3 (4.67)	8 (9.44)	7.5 (8.56)	6.2 (2.94)	7.5 (8.11)	7.4 (3.61)
T_{14}	7.4 (5.61)	8.4 (13.06)	8.5 (15.78)	7.5 (8.78)	7.7 (10.94)	7.9 (11.56)
T_{15}	7.7 (8.17)	7.9 (8.56)	7.6 (8.33)	7.3 (7.83)	7.5 (8.11)	7.6 (7.17)
T_{16}	7.5 (6.39)	7.2 (3.83)	6.7 (3.06)	6.4 (3.61)	6.4 (2.22)	6.9 (1.44)
T_{17}	8.2 (12.28)	8.1 (10.44)	6.7 (3.06)	6.8 (4.72)	6.7 (3.33)	7.3 (3.89)
T_{18}	7.8 (8.89)	8.1(10.44)	7.1 (6.00)	7.9 (11.72)	7.9 (11.33)	7.9 (11.56)
T_{19}	9.0 (18.11)	8.5 (14.22)	7.6 (8.56)	8.0 (12.61)	7.6 (10.00)	8.2 (14.94)
T_{20}	7.9 (9.83)	8.6 (14.17)	7.9 (10.89)	7.1 (6.56)	7.3 (7.28)	7.7 (9.06)
Kendall's (W) value	0.627**	0.570**	0.655**	0.696**	0.620**	0.765**

Among the tempeh chips, the highest mean score for appearance (9.0), colour (9.0), flavour (9.0), texture (8.9) and taste (8.8) was for T_2 (100 % green gram tempeh) which contributed to its high overall acceptability score of 8.9 indicating its acceptability between 'like very much ' to 'like extremely' by the panelists in a nine point hedonic scale. Tempeh chips with an overall acceptability score between 7.0 and 8.0 indicating 'like moderately' to 'like very much' were the chips made with tempeh types in which cowpea or wheat was a constituent substrate (T_6, T_{10}, T_{11}, T_{12}, T_{13}, T_{14}, T_{15}, T_{16} and T_{20}). For all other tempeh chips, the overall acceptability score were above 8.0.

The chips made from tempeh has a very high acceptability and deep frying of tempeh yield chips that are delicate, light and crisp[5]. In an another study it was found that deep fried red kidney bean tempeh slices were darker in colour compared to the soybean tempeh and had an overall acceptability score of 7.0 in a nine point hedonic scale test [6] .

These results revealed that tempeh chips with cowpea as a substrate constituent had a comparatively low score than other chips. This result is in accordance with a study which reported that tempeh products like chips and curries showed a high percentage (90%) of acceptability[7].

High palatability and acceptability of tempeh products is mainly due to the development of improved flavours and texture due to fermentation [8]. The cultures used in food fermentations are, also contributing secondary reactions to the formation of good flavour and texture [9]. During fermentation, several volatile compounds are formed which contribute to a complex blend of flavours in products [10]. According to an another study important function of the fungus *Rhizopus oligosporus* during tempeh fermentation is the synthesis of enzymes, which hydrolyse some of the substrate constituents and contribute to the development of desirable texture, flavour and aroma of the product [11].

IV. CONCLUSION

Fermented foods, whether from plant or animal origin, are an intricate part of the diet of people in all parts of the world. Indigenous fermented foods were known before recorded history, but only recently the world has taken a closer look at it as these are not only low cost and nutritious, but survived for centuries and time tested to be safe and wholesome. Legumes are one of the richest and least expensive sources of proteins in the human diet and contribute substantially to protein content of the diets of a large part of the Indian population. In Indian situation where a variety of pulses, cereals and millets are used, tempeh could be prepared with pulses other than soybeans thereby increasing the digestibility of the common pulses and cereals. Tempeh preparation does not require any special skills. Because of its high nutritional value and acceptability tempeh products will have an impact on the consumers.

BIBILIOGRAPHY

[1] Obadina, A. O., Oyewole, O. B., and Awojobi, T. M. 2008. Effect of steeping time of milled grains on the quality of *Kunnu-zaki* (A Nigerian beverage). *Afr J. Food Sci*., **2**: 33-36.
[2] Vaidehi, M. P. 1993. *Tempeh - A Unique Food for Nutrition and Health Benefits.* Biotechnology in Foods. Series No.1, Agricultural University Press, Bangalore, 65p.
[3] Jurus, M. A. and Sundberg, J. W. 1976. Penetration of *Rhizopus oligosporus* into soybeans in Tempeh. *Appl. Envion. Microbiol*. ,**32**(2): 284-287.
[4] Jellinek, G. 1985. *Sensory Evaluation of Food - Theory and Practice.* Ellis Horwood Ltd. Chichester England and VCH Verlagsgerellschaft mbh, Weinhein, Germany, 218p.
[5] Shurtleff, W. and Aoyagi, A. 2001. *The Book of Tempeh.* Ten Speed Press. Berk, California, 172p.
[6] Srapinkornburee, W., Tassanaudom, U., and Nipornra, S. 2009. Commercial development of red kidney bean tempeh. *J. Fd Agric*., **2**(3): 362-372.
[7] Vaidehi, M.P., Annapurna, M.L., and Viswanath , N.R. 1985. Nutritional and sensory evaluation of tempeh products made with soybean, groundnut and sunflower seed combinations. *Fd Nutr. Bull.* ,**7**(1): 54-57.
[8] Nout, M. J. R. and Ngoddy, P. O. 1997. Technological aspects of preparing affordable fermented complementary foods. *Fd Control* ., **8**: 279-287.
[9] Hansen, A. 2002. Generation of aroma compounds during sourdough fermentation: applied and fundamental aspects. *Trends Fd Sci Technol*., **16**: 85-95.
[10] Blandino, A., Al-Aseeri, M. E., Pandiella, S. S., Cantero, D., and Webb, C. 2003. Cereal-based fermented foods and beverages. *Fd Res. Int*., **36**(6): 527-543.
[11] Bejarano, P. A., Nadia, M., Montoya, V., Rodríguez E.A., and Cuauhtémoc, R. 2006. Tempeh flour from chickpea (*Cicer arietinum* L.), nutritional and physicochemical properties. *Fd Chem.* ,**10**(6)**:** 106-112.

