Pakistan Journal of Nutrition 5 (2): 122-124, 2006
ISSN 1680-5194

Acceptability of Tempeh among Health Workers in Ado-Ekiti, Nigeria

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Abstract: Tempeh was produced by fermenting soybeans with *Rhizopus oligosporus* NRRL 2710. The bacterial and fungal counts of fresh tempeh samples were $8.2x10^6$ cfu/g and $7.17x10^6$ cfu/g respectively. The pH of the soybean substrate increased from 5.6 to 6.92; while the moisture content decreased from 20.30% to 16.5% during fermentation. Acceptability of the processed tempeh among health workers in Ado-Ekiti was assessed by administering a questionnaire along with the tempeh. Responses by sixty one (61) individuals was analysed by chi-square at 5% level of significance. Acceptability of tempeh among the Moslems was significantly higher than among Christians. The differences in acceptability of tempeh based on sex, age, marital status and profession were not significant (at $p \leq 0.05$). Generally, there was a positive response as 77.05% of the health workers readily accepted tempeh.

Key words: Acceptability, tempeh, health workers

Introduction

Tempeh is a fermented soybean product which is consumed as a staple food in Indonesia, Southeast Asia (Steinkraus *et al.,* 1983). Nowadays, tempeh is becoming more popular in Japan, USA and Western Europe, especially in the diets of vegetarians. Soybean is fermented for 1-2 days at temperature ranging from 30-35°C during which the mycelium develops throughout the mass of beans, knitting it together. The pH rises to around 7.00 during which fungal proteases increase the free amino acids content of the product and lipases hydrolyze over a third of the neutral fat present to free fatty acids (Adams and Moss, 1999). This fermentation process completely transforms the soybeans to produce a new flavor, aroma, texture and also increases their nutritional value and digestibility.

Tempeh production involves the use of fungal starter culture. Strains of *Rhizopus* species are the most acceptable. Examples include *Rhizopus oligosporus, R. oryzae, R. stolonifer, etc* (Barz and Rehms, 1995), but the most acceptable of them all is *R. oligosporus.* Strains of both *R. oligosporus* and *R. oryzae* have high proteolytic capacities while *R. stolonifer* are less active (Baumann and Bisping, 1995).

Production and consumption of tempeh is a novel idea in Nigeria. Feasibility studies on the acceptability of a new product by the prospective consumers ought to be conducted to prevent product failure (Koetzee, 2001). Ado-Ekiti is a state capital in Southwest Nigeria. Studies have been conducted on the acceptability of tempeh among Primary and Secondary School students (Aderibigbe *et al.,* 2004); and among the University of Ado-Ekiti community. However, it is also necessary to confirm the acceptability of the tempeh among the general working class, particularly the civil servants. Thus this paper reports the acceptability of tempeh among health workers in Ado-Ekiti, which is a multidisciplinary group that represents the working class (civil servants).

Materials and Methods

Source of materials: Soybeans (*Glycine max)* was purchased from the local (King's) Market in Ado-Ekiti. The *Rhizopus oligosporus* strain NRRL 2710 was obtained from GEM Cultures, California and maintained on Malt Extract Agar (MEA, Oxoid) slants in the Microbiology Laboratory, University of Ado-Ekiti.

Preparation of inoculum and tempeh: The method of Aderibigbe and Kolade (2003) was used to prepare the inoculum (spores' suspension). The mold was grown on MEA (Oxoid) plates. The spores' count was determined by serial dilution and plating; and expressed as cfu/ml. Tempeh was prepared using one of the Indonesian traditional methods as described by Aderibigbe and Adebayo (2002)

Microbiological and biochemical analyses:
Determination of microbial load: The microbial load of fresh tempeh was determined by serial dilution and plating. The pour-plate method was used. Nutrient agar (NA, Oxoid) and MEA were used to enumerate bacterial and fungal counts respectively, which were expressed as cfu/g.

Characterization of bacterial isolates: Distinct bacterial colonies were subcultured unto fresh NA plates to obtain pure cultures. Cultural characteristics were observed. Also Gram-staining, catalase and coagulase tests were performed on the isolates.

Determination of pH and moisture content: The pH and

Table 1: Acceptability (%) of tempeh among health workers in Ado-Ekiti on bases of sex, religion and marital status

Factor		No of Respondents	Acceptability (%)		
			YES	IND	NO
Sex:					
	Male	29	22 (75.86)	3 (10.34)	4 (13.79)
	Female	32	25 (78.12)	2 (6.25)	5 (15.63)
Religion:					
	Christians	45	34 (75.56)	4 (8.88)	7 (15.56)
	Moslems	16	13 (81.25)	1 (6.25)	2 (12.5)
Marital Status:					
	Single	20	15 (75)	1 (5.00)	4 (20.00)
	Married	41	32 (78.05)	4 (9.75)	5 (12.20)

KEY: IND means indifferent. Percentage values in parentheses.

Table 2: Acceptability (%) of tempeh among health workers in Ado-Ekiti on bases of age and profession

Factor	No of Respondents	Acceptability (%)		
		YES	IND	NO
Age (yrs):				
21-25	10	8 (80.00)	1 (10.00)	1 (10.00)
26-30	9	7 (77.78)	0 (0.00)	2 (22.22)
31-35	22	17(77.27)	2 (9.09)	3 (13.64)
35 and above	20	15 (75.00)	2 (10.00)	3 (15.00)
Profession:				
Doctors & Pharmacists	11	9 (81.81)	1 (9.09)	1 (9.09)
Nurses	24	19 (79.17)	1 (4.16)	4 (16.67)
Laboratory workers &Physiotherapists	8	6 (75.00)	0 (0.00)	2 (25.00)
Others (junior staff)	18	13 (72.22)	3 (16.67)	2 (11.11)

KEY: IND means indifferent. Percentage values in parentheses.

moisture content of tempeh samples were determined using the methods described by Aderibigbe and Adebayo (2002). A digital pH meter (Thermo, BE 105) equipped with a glass electrode that was standardized with a buffer solution (pH 7.0) was used to determine the pH of the slurry preparations. An oven (Gallenkamp B5250) preset at 70^{o}C was used to dry preweighed samples till constant weight. The percentage moisture content was calculated.

Organoleptic evaluation: The fresh tempeh was seasoned with salt, maggi and curry and fried in heated vegetable oil until it was golden brown. One gram (1g) each of the fried tempeh was served to sixty one (61) health workers in Ado-Ekiti, along with a questionnaire for evaluation. The parameters assessed included the flavour, appearance, texture and taste. The overall/general assessment was on a 7-point Hedonic scale (Larmond, 1977), given numerical values of 1 (dislike extremely) through 7 (like extremely). Responses were analysed on the bases of sex, religion, marital status, age and profession. Differences in acceptability (%) were compared statistically using chi-square at 5% level of significance.

Results

The spore count of the inoculum was $1.15x10^{9}$ spores/ml. The bacterial and fungal counts of the fresh tempeh were $8.2x10^{6}$ cfu/g and $7.17x10^{6}$ cfu/g respectively. On the basis of cultural characteristics, three bacterial isolates (TB_1, TB_2 & TB_3) were obtained. Isolate TB_1 was Gram-positive single rods that were catalase and coagulase negative. The isolate TB_2 was Gram-positive paired cocci which were catalase positive and coagulase negative. However, isolate TB_3 was Gram-positive cocci in chains, catalase and coagulase positive.

The pH of the substrate increased from 5.6 to 6.92, while the moisture content decreased from 20.3% to 16.5% during fermentation.

Table 1 shows the percentage acceptability of tempeh on the bases of sex, religion and marital status; while Table 2 shows the acceptability on the bases of age and profession. Twenty nine (29) males and 32 females participated in the assessment. Analysis by chi-square (at 5% level of significance) confirmed that the difference in the percentages of males and females who accepted tempeh was not significant. Similarly, the effects of age,

marital status and profession on acceptability of tempeh were not significant (at $p \leq 0.05$). However of the 45 Christians and 16 Moslems that responded, a significantly higher percentage of Moslems accepted tempeh than Christians. Generally, 77.05% of the health workers involved in this study indicated positively their acceptance of tempeh.

Discussion

A total (bacterial and fungal) count of 1.5×10^7cfu/g was obtained in this study which compared favourably with 5.4×10^7cfu/g that was reported by Aderibigbe and Adebayo (2002). Gram-positive rods and cocci have been reported to be associated with fermentation of many plant seeds (Ogbadu and Okagbue, 1988; Reddy *et al.,* 1986). Microbiological studies during tempeh production have also implicated the presence of Gram positive bacteria. Non-adherence to strict aseptic techniques in the traditional method of tempeh production could be responsible for the presence of coagulase-positive *Staphylococcus* specie. Though the pH of the tempeh in this study was comparable to that reported earlier (Aderibigbe and Adebayo, 2002), the moisture content of samples in this study were much lower.

It has been reported that 76.27% and 62.17% of Primary School pupils and Secondary School students in Ado-Ekiti respectively accepted tempeh as snack (Aderibigbe *et al.,* 2004). Thus the 77.17% acceptance by the health workers is a further indication of the acceptance of tempeh by the various people groups in Ado-Ekiti. Considering the nutritive potentials of tempeh, and being a low-cost source of protein and vitamin B_{12}, the necessity to commence its production on commercial basis is imperative.

References

Adams, M.R. and M.O. Moss, 1999. Food Microbiology 1st Edn. pp 296-298. Royal Society of Chemistry, Cambridge.

Aderibigbe, E.Y. and C.O. Adebayo, 2002. Fermentative utilization of soybean in Nigeria. I: Laboratory production of tempeh. NISEB J., 2: 31-35.

Aderibigbe, E.Y., B.A. Alabi and O.A. Onifade, 2004. Acceptability of tempeh as snack among Primary and Secondary school students in Ado-Ekiti, Nigeria. J. Biol. Phys. Sci., 2: 6-12.

Aderibigbe, E.Y. and K.B. Kolade, 2003. Propagation of tempeh *Rhizopus oligosporus* I: Use of organic food wastes. Nig. J. Biotech., 14: 78-84.

Barz, W.H. and H. Rehms, 1995. Degradation of starch, raffinose, mellibiose and sucrose by different tempeh-producing *Rhizopus* fungi. Appl. Microbiol. Biotec., 44: 47-52.

Baumann, V. and B. Bisping, 1995. Proteolysis during tempeh fermentation. J. Food Microbiol., 12: 39-47.

Koetzee, H., 2001. Market testing new food products with illiterate and semi-literate consumers. Food Chain, 29: 19-21.

Larmond, E., 1977. Laboratory Methods for Sensory Evaluation of Food 1st Edn., pp: 18, 57. Canada Publishing Centre, Canada.

Ogbadu, L.J. and R.N. Okagbue, 1988. Bacterial fermentation of soya bean for 'dawadawa' production. Appl. Bacteriol, 65: 353-356.

Reddy, N.R., M.D. Pierson and D.K. Salunkhe, 1986. Legume-Based Fermented Foods. CRC Press Inc., Boca-Raton, Fla.

Steinkraus, K.H., R.E. Cullen, C.S. Pederson, L.F. Nellis and B.K. Gavitt, 1983. Indonesion tempeh and related fermentations. In : Handbook of Indigenous Fermented Foods 1st Edn. pp: 1-94. Marcel Dekker Publishers, New York.