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Research Article

Sensory evaluation and protein and methionine content analysis of different beans for tempeh production

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Abstract

A tempeh product was prepared from soybeans fermented by *Aspergillus oligosporus*. The aims of this research were produce tempeh from different beans using soybeans (control), soybeans with black sesame seeds, peanuts with black sesame seeds and white kidney bean with black sesame seeds (beans : black sesame seeds, 100:1 g/g.) for full nutrition. All types of tempeh were evaluated for sensory properties (structure, flavour, aroma, acceptability) by 50 teenage panelists and protein/methionine content was also analyzed. White kidney bean with black sesame seed tempeh was rated as more satisfying than other tempeh, but had the least protein content (13.74%). Methionine content increased when black sesame seeds were added in tempeh production. This research indicated that, white kidney bean with black sesame seed tempeh can contribute to an increase in essential nutrition and is appropriate to select for the diet of teenagers.

Keywords: soybean, peanuts, white kidney bean, *Rhizopus oligosporus*, black sesame seed, *Aspergillus oligosporus*, fermentation, Thailand.

Introduction

Tempeh is a food originally from Indonesia. It is made by fermentation of soybeans using microorganisms. Soybean tempeh is rich in nutrients, high in protein content and fibre which are necessary characteristics for a healthy diet. For cooked tempeh, tempeh is often prepared by cutting it into pieces, soaking in brine or sauce and then frying. It can be eaten alone or used in chili, stir fry, soups, salads, sandwiches and stews. Soybean contains all three of the macro-nutrients required for good nutrition namely complete protein, carbohydrate and fat, as well as vitaminB-12, which is a by-product of the fermentation process, and minerals, including calcium, folic acid and iron [1]. Soybean provides all 9 essential amino acids which are necessary for the building and maintenance of human body tissues [2] but is limited in methionine and cysteine. *Rizopus oligosporus* is the fungus that is a widely used starter culture

for production of tempeh [3] although some moulds such as *R. oryzae* and *Mucor* spp., may also contribute to the flavour, texture or nutritive value. Mulyowidarso *et al* [4] also reported variable growth of bacteria during fermentation of soybean tempeh with *R. oligosporus*. Liem *et al*. [5] reported that *Klebsiella pneumoniae* was responsible for the produced vitamin B12 in tempeh. In addition, tempeh can produced from other types of bean [6]. Many kinds of beans are extensively cultivated in Thailand such as peanut and white kidney bean. Peanut has many uses. They can be eaten raw and are a good source of fat, fibre and protein. Peanut contains antioxidants and arginine, which is an amino acid known to decrease blood pressure. Eating raw peanut may reduce the risk of certain chronic diseases such as coronary heart disease, diabetes and gallbladder disease. White kidney bean or cannellini bean are a member of the *Phaseolus vulgaris* species. They are similar to navy beans, which are commonly sold as "baked beans". Some studies have shown that white kidney beans benefit bean weight loss [7, 8, 9]. When human subjects were given 445 mg of a white kidney bean extract per day for 30 days, it was found that they lost significantly more weight and fat compared to those receiving a placebo. Furthermore, weight loss occurred with the maintenance of lean mass [7]. Currently, teenagers who are overweight or even at a healthy weight may have a distorted idea of body image because of peer pressure, media depictions of models and related factors. Consequently, some teenagers choose to diet in unhealthy ways, such as severely restricting calories, eating unbalanced meals and snacks or trying quick-fix diet pills. White kidney bean is a new choice for diets because the extract contains “Phaseolamin”, which can inhibit alpha amylase [10], which essentially limits carbohydrate digestion and absorption. To most people, this effect is known as "carb blocking" [11, 12]. Currently, consuming a mixture of beans with black sesame seed is becoming popular to get essential and complete amino acids, especially for vegetarians. Soybean has high protein content but is lacking in methionine. High levels of methionine can be found in black sesame seeds and they are known as a source of food and oil [13]. Thus, this study aims to produce tempeh with full nutrition from the mixture of several types of bean with black sesame seed, to test acceptability using sensory evaluation and to measure the amount of protein and methionine in the tempeh.

Materials and Methods

Rhizopus oligosporus was obtained from Thailand Institute of Scientific and Technological Research (TISTR). Soybean, peanuts, white kidney beans and black sesame seed were purchased from a local market in Bangkok.

Preparation of starter culture

The inoculums were prepared from pure culture of *Rhizopus oligosporus* grown on potato dextrose agar (PDA) plate. The plate culture was sub-cultured periodically on PDA slant and incubated at room temperature for 3-5 days until the white mycelium and back spores were apparent.

Proportion evaluation of starter culture and black sesame seed

100 g. of soybeans were soaked in tap water for 16-18 h. until the hulls can be removed easily by rubbing. After dehulling, the soybeans were boiled in tap water 30 min, drained and surface dried at room temperature. Tempeh productions were divided into 2 sets. First set: 2, 4, 6 ml of 10^8 cfu/ml starter cultures were added, mixed and spread. Other set: black sesame seeds were added by varying ratios of soybeans to black sesame seeds; 100:0.5, 100:1 and 100:1.5 (g/g) mixing and 4 ml of starter culture were added, mixed and spread. Both sets of tempeh were tightly packed in plastic bags and incubated at room temperature for 18-48 h. At the end of this period, mycelium cover was observed on the tempeh as shown in Figure 1. Among these three volumes of starter culture, 4 ml was selected as the best starter culture for 100 g. of tempeh

production. As shown in Figure 2, among these three ratios of black sesame seed, 100g. of soybeans : 1 g. of black sesame seeds was selected as the best ratio for tempeh production.

Preparation of mixed beans and tempeh process

Soybeans, peanuts and white kidney beans were used as substrate for tempeh production process as shown in Figure 3. Code of Different Beans as A1: Soybean with black sesame seed tempeh A2: peanut with black sesame seed tempeh A3: white kidney bean with black sesame seed tempeh and A4: soybean tempeh was used as control.

Sensory evaluation

Four different tempeh products were served to 50 teenage panelists with a questionnaire for evaluation. The parameters assessed include the structure, flavour and aroma acceptability. The sensory evaluation was carried out by using two points, satisfied and dislike**.**

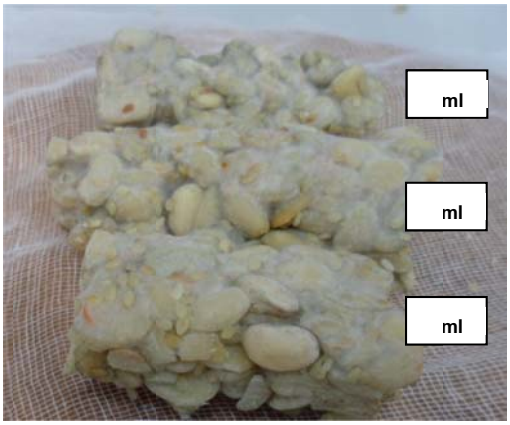

Figure 1. Volumes 2, 4, 6 ml of starter cultures were added in tempeh production.

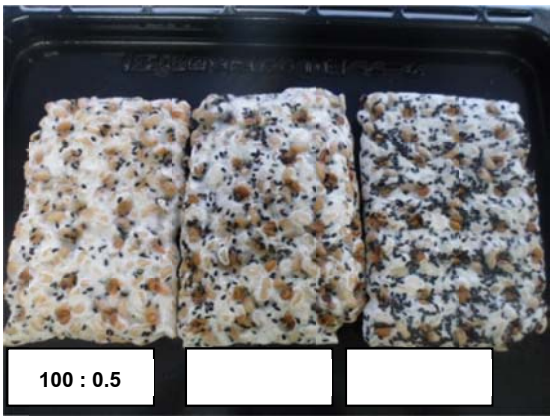

Figure 2. Varying ratio of soybeans to black sesame seeds are 100:0.5, 100:1, 100:1.5 (g/g).

Protein and methionine analysis

Protein content of different of tempeh was analyzed by The Kjeldahl method at Food Research and Testing Laboratory Chulalongkorn University. Methionine content analyzed by in-house method based at Central Laboratory (Thailand) Co. Ltd.

Results and Discussion

Sensory evaluation

Fried tempehs were served to 50 teenage panelists with a questionnaire for sensory evaluation. The parameters assessed include the structure, flavour and aroma acceptability (Fig.4). It appears that white kidney bean with black sesame seed tempeh (A4) was the most satisfying in all parameters; the structure (Fig.4,A)), flavour (Fig.4,B)) and aroma (Fig.4,C)) were 44, 39 and 43 panellists, respectively. Peanut with black sesame seed (A2) tempeh was the least satisfied of the structure and flavour acceptability.

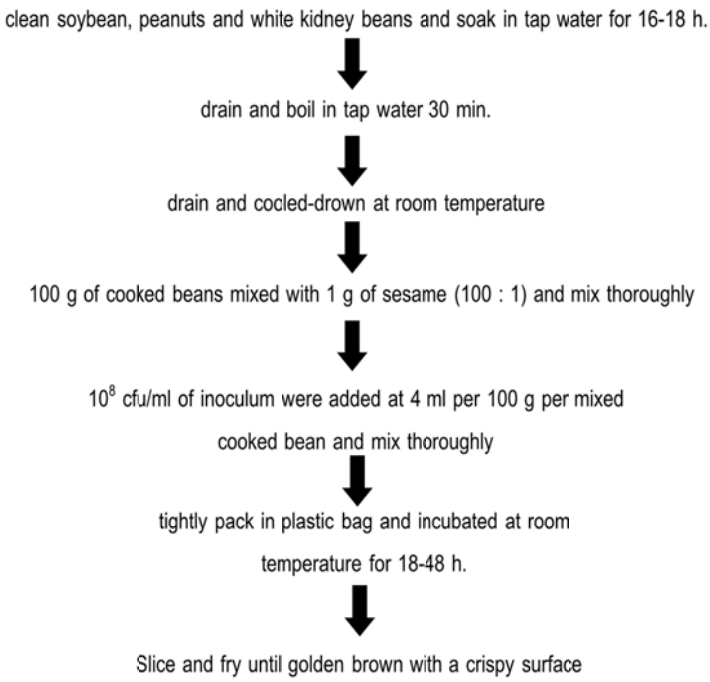

Figure 3. Process for mixed bean tempeh production.

Protein content

The results of protein content of different tempeh products are reported in Table1. The table shows that highest protein content was found in soybean and soybean with black sesame seed tempehs at 21.53% and 21.93%, respectively. This indicated that soybean itself is one of the richest sources of protein. White kidney bean tempeh protein content is significantly less than soybean tempeh by about 8%.

Table.1 Protein content of different tempeh.

sample	% crude protein
A1	21.93 ± 0.7439
A2	18.44 ± 0.0565
A3	13.74 ± 0.2844
A4	21.52 ± 0.1500

A1: soybean with black sesame seed, A2: peanut with black sesame seed, A3: white kidney bean with black sesame seed and A4: soybean without black sesame seed (control).

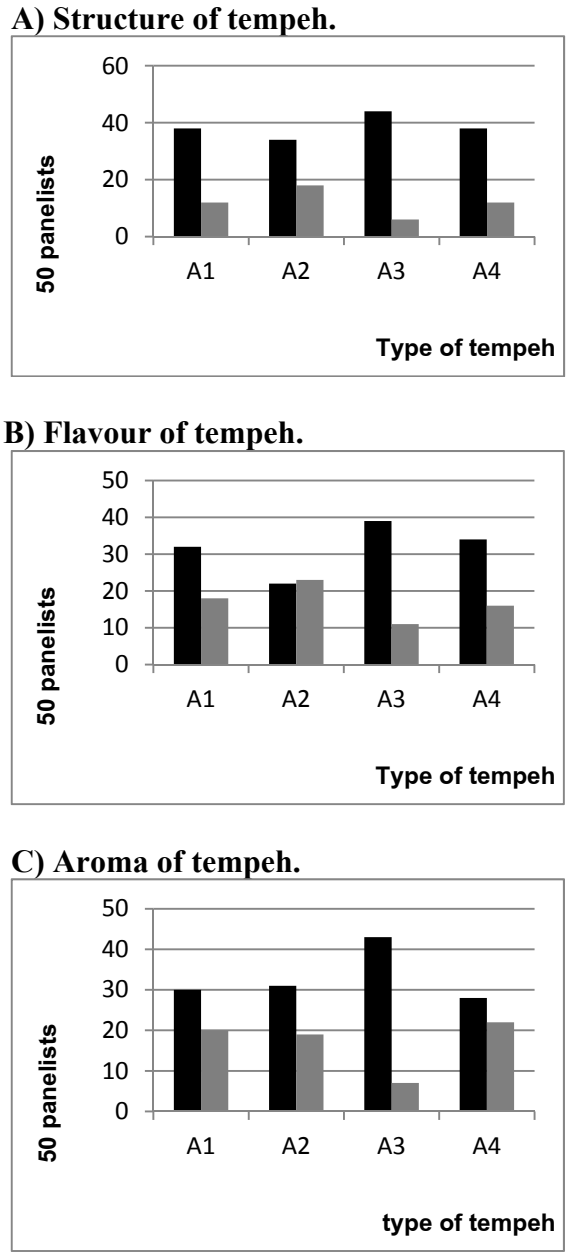

Figure 4. Sensory evaluation of different tempeh from 50 teenagers.

A1: soybean with black sesame seed, A2: peanut with black sesame seed, A3: white kidney bean with black sesame seed and A4: soybean without black sesame seed (control); ■ satisfied, ■ dislike

Methionine content in tempeh

Table2 is a comparison of methionine content in tempeh with added black sesame seed. The table shows that when added black sesame seeds by ratio of soybeans/white kidney beans to black sesame seeds were 100:1 g/g, methionine content increased from 188.74 mg/100g to 197.64 mg/100g and from 105.19 mg/100g to 116.98 mg/100g in soybean tempeh and white kidney bean tempeh, respectively.

Table 2. Methionine content of tempeh.

sample		Methionine (mg/100g)	sample	Methionine (mg/100g)
Soybean tempeh		188.74	white kidney bean	105.19
Soybean tempeh with black sesame seed		197.64	white kidney bean with black sesame seed	116.98

Conclusion

Tempeh products were prepared from different beans and evaluated for sensory characteristics; structure, flavour and aroma acceptability. From results of this research, white kidney bean with black sesame seed was the most satisfactory and this may be due to good appearance and teenagers often select their diet based on popularity. Protein content among the 4 types of tempeh products studied, the protein content of soybean and soybean tempehs were higher than that of the others. White kidney bean tempeh had the least protein content but it is still higher in protein than some other food. From the results of sensory evaluation, white kidney bean with black sesame seed tempeh was selected and analyzed methionine content. When soybean and white kidney bean tempeh were added with black sesame seed in ratio beans:black sesame seeds to 100:1 (g/g), methionine content increased. These results indicated that white kidney bean with black sesame seed tempeh can increase essential nutrition therefore white kidney bean with black sesame seed is selected as a new tempeh product for the diet of teenagers.

Acknowledgements

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