International Food Research Journal 23(1): 262-268 (2016)
Journal homepage: http://www.ifrj.upm.edu.my

Effect of oyster mushroom *(Pleurotus sajor-caju)* addition on the nutritional composition and sensory evaluation of herbal seasoning

Saiful Bahri, S. and *Wan Rosli, W. I.

Nutrition Program, School of Health Sciences, Universiti Sains Malaysia, Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia

Article history

Received: 13 January 2015
Received in revised form: 10 May 2015
Accepted: 12 June 2015

Keywords

Herbal seasoning
Pleurotus sajor-caju powder (PSC)
Proximate compositions
Total dietary fibre (TDF)
Sensory acceptability

Abstract

The present study was conducted to investigate the effect of oyster mushroom (Pleurotus sajor-caju, PSC) addition to partially replace coconut milk powder on nutritional composition and sensory values of Herbal Seasoning (HS). This study evaluates the nutritional composition, dietary fibre and sensory acceptance of HS that processed using six different formulations with different levels of PSC powder, namely 0% (A), 20% (B), 40% (C), 60% (D), 80% (E) and 100% (F). The use of PSC powder substantially brought down the fat content of HS. The fat content of PSC-based HS was ranged from 13.82±0.84% to 8.16±0.74%. The protein content showed an increasing trend in line with increasing of PSC powder ranging from 7% to 12%.Substitution of coconut milk powder with PSC powder resulted in significantly higher ($p<0.05$) of total dietary fibre content (TDF). The TDF content was ranging from 15.53% to 22.02%. The sensory evaluation showed that both HS contained 100% and control were not significant different ($p>0.05$).The panels preferred HS formulated with PSC powder since its enhance colour and viscosity attributes of the products. In brief, HS formulated with more than 40% PSC powder is recommended since it has significant nutrients and palatably accepted by sensorial panellists.

Introduction

Food paste has always been one of the most popular and appealing food products due to its easy to prepare, convenient, nutritionally formulated, ready to eat (RTE), as well as cost competitiveness. Now, the food industry is an extremely competitive one and its role is very significant in manufacturing healthy food items for health conscious consumers.

Mushrooms also called white vegetables or boneless vegetarian meat that can provide balance diet in sufficient quantities for human nutrition and contain various potent pharma-nutritional compounds. The cultivation, production and application of mushrooms are tremendously increasing very fast throughout the world, mainly due to their nutritional properties and medicinal attributes and their unique flavour and texture (Ares, 2007). Hence, the uniqueness of promising food ingredients and flavour together with enhanced health promoting properties in mushrooms is at present one of the key global market trends (Netzel *et al*., 2007).

The increasing public awareness associated with dietary fibre which exert various potential health benefits has undoubtedly encouraged food manufacturers to develop fibre-enriched or fibre-fortified food products such as snack foods, beverages, cookies and canned meat (McKee and Latner, 2000; Sloan, 2001). Dietary fibre means carbohydrate polymers with ten or more monomeric units, which are not hydrolyzed by the endogenous enzymes in humans (Codex Alimentarius, 2010). Dietary fibre also involved in disease prevention which contribute to physiological attenuations such as decrease in blood glucose levels, cholesterol and fat binding and facilitating good colonic health (Foschia *et al*., 2013). Moreover, consumers also believe that foods directly contribute to their health status (Mollet and Rowland, 2002).

Herbal seasoning is one type of food paste and generally prepared from composite mixture of coconut-mushroom as key ingredients. All these ingredients will impart characteristic acceptance, colour, viscosity and nutritional value which may be favourable in food paste products, recipes and other food products.

Incorporation of oyster mushroom powder with herbal ingredients give new good combination to diversify the application of herbs and mushroom in RTE food products. For a long time, RTE foods are usually associated to negative side effects related to health such as high in sugar, fat and calorie content which responsible for the obesity, high blood pressure and consequently reduce quality of life (Szabo, 2011).

*Corresponding author.
Email: rosliishak@gmail.com
Tel: +609-767 7779; Fax: +609-7677515

Mushroom generally consists of approximately 90% water content. Due to the most perishable nature of mushrooms, processing is needed to extend the shelf life for off-season commercial use (Devece *et al*., 1999). Thus, the application of drying technique is one method to widen the usage of PSC powder. Interestingly, they are rich in crude fibre and protein. They are also contains low fat, low calories and essential vitamins and possess multi-functional medicinal properties (Manzi *et al*., 2001). Recently, the issues regarding the human nutrition are always being important and the outbreak of food related to animal meat sources has becomes the issues to be more complicated. The increase in human population globally necessitates a need for exploration of the other source of proteins. Therefore, the continuous investigation of naturally ingredients or substances becomes a good reason for nutritional substitute to the existing foods. Today, many foods introduced to the market contain mushrooms as the main ingredients. The trend offers value added benefits based on the existing products and also invention to the new products. On the other hand, culinary herbs have a wide range of uses in food preparation. Due to their strong flavours, these food items are frequently used in small quantities to generate pleasant flavour.

Previous study was successfully done in substituting white flours with oyster mushroom powder in bakery products, soups, sauces, instant noodle, meat-based products, pasta and flour mixes. Recently, it was discovered that oyster mushroom powder has improved some nutrients content of butter biscuit (Wan Rosli *et al*., 2012) and rice-based products (Aishah and Wan Rosli, 2013).

Presently, foods are not intended to only satisfy hunger and to provide necessary nutrients for humans but also to prevent some nutrition-related diseases and improve physical and mental well-being (Neothlings *et al.*, 2007; Takachi *et al.*, 2008). Hence, the purpose of the present study was to investigate the nutritional content and dietary fibre in different ratios of oyster mushroom powder and the acceptance of the HS products. The findings from the present study are vital for embarkation of future research on the antioxidant activities and other pharma-nutritional properties of HS added with mushroom.

Materials and Methods

Preparation of PSC powder

Oyster mushroom (*Pleurotus sajor-caju*, PSC) were supplied by Anjaad Manufacturing Sdn. Bhd, a local small medium company in Malacca, Malaysia. The dried samples were ground into powder form by using food grinder (National MX 895M) and kept in sealable plastic bag prior to analysis.

Preparation of herbal seasoning

The HS were prepared by using a mixture of locally available herbs, blended spices, oyster mushroom powder and coconut milk powder. All local culinary herbs were purchased from local wet market. Coconut milk powder was substituted with *Pleurotus sajor caju* (PSC) powder at the level of 0% (A), 20% (B), 40% (C), 60% (D), 80 % (E) and 100% (F). The composite powders and other dry ingredients were mixed with culinary herbs in a jacketed kettle before distilled water was added. The pH of the mixture was adjusted to less than 4.5 with citric acid and the mixture was then heated to boiling. This is followed by hot filling into pasteurized bottles of 230 g followed by processing in boiling water until the temperature of the central region of the product reaches 93^{o}C. The finished products were then kept at room temperature until further analyses.

Proximate compositions and total dietary fibre (TDF) analysis

Proximate analysis were conducted using AOAC (2000) for moisture (Air-oven method), total ash, crude protein by nitrogen conversion factor of 6.25 (Kjeldahl method) and crude fat content using the semi-continuous extraction (Soxhlet method). Total dietary fibre was determined by enzymatic gravimetric method, based on the AOAC (2000). All measurements were carried out in triplicate (n = 3).

Sensory evaluation

Sensory evaluations were carried out by 50 untrained consumers consisting of students and staffs of the School of Health Sciences, Universiti Sains Malaysia, Health Campus, Kelantan. They evaluated samples for aroma, colour, viscosity, hotness, sourness, aftertaste and overall acceptability on a 7 point scale (1 = dislike extremely and 7 = like extremely).

Data analysis

Data were analyzed according to one-way ANOVA procedure by using SPSS 19.0 (USA). Results were expressed as mean ± standard deviation. All measurements were carried out in triplicate (n = 3). Significant level was established at $P<0.05$.

Results and Discussion

Proximate compositions

Proximate composition of HS enriched PSC

Table 1. HS formulated with different level of PSC

	PSC powder level (%)					
Ingredients (%)	0	20	40	60	80	100
Mushroom powder	0	4	8	12	16	20
Coconut milk powder	20	16	12	8	4	0
Dried chili	1.6	1.6	1.6	1.6	1.6	1.6
turmeric	1.1	1.1	1.1	1.1	1.1	1.1
Ginger	1.7	1.7	1.7	1.7	1.7	1.7
Galangal	0.8	0.8	0.8	0.8	0.8	0.8
Onion	20.4	20.4	20.4	20.4	20.4	20.4
Shallot	9.4	9.4	9.4	9.4	9.4	9.4
Garlic	2.4	2.4	2.4	2.4	2.4	2.4
Cumin powder	0.8	0.8	0.8	0.8	0.8	0.8
Fennel powder	0.8	0.8	0.8	0.8	0.8	0.8
Coriander	1.6	1.6	1.6	1.6	1.6	1.6
Coconut crude	6.3	6.3	6.3	6.3	6.3	6.3
Dried lime	0.4	0.4	0.4	0.4	0.4	0.4
Salt	2.4	2.4	2.4	2.4	2.4	2.4
Black pepper	0.4	0.4	0.4	0.4	0.4	0.4
Lemon grass	1.6	1.6	1.6	1.6	1.6	1.6
Water	26.7	26.7	26.7	26.7	26.7	26.7
Citric acid	0.4	0.4	0.4	0.4	0.4	0.4
Sugar	1.6	1.6	1.6	1.6	1.6	1.6
'Bunga Kantan'	10	10	10	10	10	10
Turmeric leaves	20	20	20	20	20	20
'Daun limau purut'	10	10	10	10	10	10
'Pegaga'	60	60	60	60	60	60

powder with six different formulations are shown in Table 2. The addition of PSC powder has resulted significantly increased ($p<0.05$) of moisture content and protein content while at the same time was significantly decreased ($p<0.05$) in fat content. However, these changes were only significant ($p<0.05$) when PSC powder was added in the HS formulations. Herbal seasoning added with PSC powder had moisture content in the range of 58.76% to 62.69%. Proximate analysis indicated that HS substitute with more than 60% PSC powder had higher moisture content.

The moisture content of control sample was the lowest (58.76%) and the HS with 80% substitution of PSC powder (62.69%) had the highest moisture content. However, sample with 40% PSC powder substitution and higher were not significant different ($p>0.05$) among each others. Generally, fresh mushroom (*Pleurotus* species) contain 85-95% moisture (Khan 2010; Aisyah and Wan Rosli, 2013). Proximate analysis indicated that HS added with more than 40% PSC powder had the highest moisture content which could be related to the water content and water holding capacity of PSC powder. PSC powder possess high water content and water holding capacity that linked to the higher moisture content in HS added with PSC powder. It was from the sugar and dietary fibre (starch) available in PSC powder which may absorb large amount of water content (Mohamed *et al*., 2010).

In addition, high dietary fibre and protein content could contribute to the increase of water holding capacity resulting higher water absorption of oyster mushroom powder. The viscosity of HS increased significantly with the addition of PSC powder, while the yield was decreased upon the addition level of PSC powder introduced in HS formulations. The present findings were in agreement with (Hyung Hong *et al*., 2005) on the addition of PSC powder to substitute wheat powder in bread making. They found that the loaf weight increased, while the loaf volumes decreased.

On the other hand, the concentration of fat was inversely proportional to the PSC powder levels in HS. All data reported on dry basis. Generally, HS had relatively high in fat content ranged from 8.16% to 13.82% which was not surprising for all coconut-based foods. On the other hand, the introduction of coconut crude 'kerisik' at amount of 6.3% showed the total fat content of product is consider high. HS prepared from HS(F) was significantly ($p<0.05$) recorded the lowest in fat (8.61%) content than other treatments. In addition, HS (E) ranked the second lower in fat content (9.25%). As expected, the highest fat content was recorded in control sample which was 13.82%. The highest fat content was corresponded to the lowest moisture content detected in control HS.

Ash content was generally high in all treatments ranging from 14.27% to 15.72%. Basically, ash content gives a rough idea about the mineral content of the product. Interestingly, changes in proximate composition of HS added with PSC powder resulted

Table 2. Proximate analyses of HS incorporated with PSC

Proximate	Treatment					
	A (0%)	B (20%)	C (40%)	D (60%)	E (80%)	F (100%)
Moisture	58.76±2.25 c	60.43±3.21 bc	61.08 ±2.48ab	62.49 ±2.36 a	62.69 ±3.35 a	62.09 ±3.65ab
Fat	13.82±0.84 a	13.2±0.65 b	11.88±0.65 c	10.03±0.54 d	9.25 ±0.95d	8.16±0.74 e
Ash	14.32±0.25c	15.11±0.22 b	15.72 ±0.69a	15.09±0.45 b	14.27±0.28c	14.40 ±0.38c
Protein	7.12 ±0.25 f	9.15±0.15 e	9.37±0.28d	10.74±0.87 c	11.14±0.25 b	11.67 ±0.45a
Carbohydrate	47.71±0.88a	46.33± 0.92b	45.81±0.29c	45.31±0.74 c	43.32±0.25d	45.58±0.55c

a-e Mean values with different letters are statistically different (p<0.05)

in increment of protein content significantly (p<0.05) for about 42% in HS(F)(11.67%). Meanwhile, control sample (A) had the lowest protein content (7.12%). The protein content showed the increasing trend in line with the PSC powder substitution. Interestingly, the nutritional value of mushrooms is primarily related to their protein content. In fact, mushroom protein is considered to have higher nutritional quality than that of plant proteins (FAO, 1991).

Colak *et al.* (2009) has stated that the protein content of mushroom is not only dependent on environmental factors and stage of fruiting body maturity, but also on species. The increase in these chemical compositions could be probably due to their high quantities of nutritional composition in oyster mushroom powder. According to Okaka (2005), cereals such as wheat flour are lower in protein and lysine deficient but rich in sulphur containing amino acid. Furthermore, protein, carbohydrate and ash content of mushrooms are also significantly affected by their technological process (Manzi *et al*., 2001).

The highest protein and the lowest fat percentage in HS (F) may due to the moderate amount of protein (23.3%) and fat content (3.0%) existing originally in dried PSC powder used in this study (Wan Rosli *et al.*, 2011; Aisyah and Wan Rosli, 2013). Furthermore, the dry matter of mushroom fruit bodies is about 5–15%. They also have a very low fat content and contain 19–35% proteins. Mushroom fruit bodies are plentiful of vitamins, mainly B1, B2, C and D2 (Manzi *et al*., 1999; Mattila *et al*., 2000). It is speculated that the differences (p<0.05) observed in protein content between treatments could be partially explained by the differences in moisture content.

Aisyah and Wan Rosli (2013) used PSC powder in formulation of porridge and bakeries products also getting the similar findings. The porridge added with 6% PSC powder was increased significantly (p<0.05) for protein (1.47g/100 g) and ash content (1.23 g/100 g) compared to the control for protein (1.12 g/100 g) and ash content (0.7 g/100 g) respectively. On the other hand, carbohydrate content was reduced as a result of PSC powder addition in the HS formulations in the range of 43.75%- 47.71%.

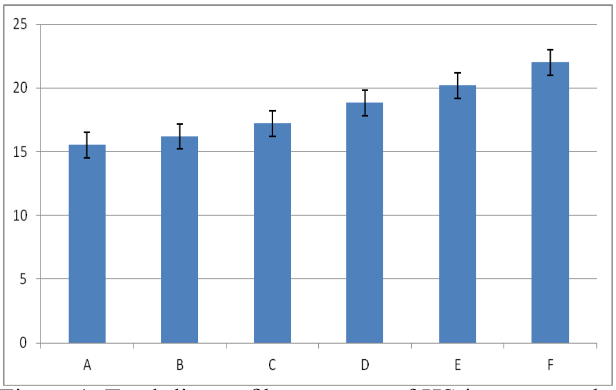

Figure 1. Total dietary fibre content of HS incorporated with PSC
a-d Mean values with different letters are statistically different (p<0.05) (A=0% PSC, B=20% PSC, C= 40%PSC,D= 60% PSC, E=80% PSC, F=100%PSC)

Total dietary fibre

Total dietary fibre content (TDF) of HS is shown in Figure 1. Initially, the TDF concentrations of HS increased proportionally with the levels of PSC powder added in the HS formulations. All PSC- based HS recorded fibre content ranging from 15.53% to 22.02% and significantly higher (p<0.05) than control HS which recorded 15.53%. Control sample (15.53%) showed the lowest content of TDF and was no significant different (p>0.05) with HS (B) (16.20%). Interestingly, HS (F) showed the highest content of TDF (22.02%) and was significant different (p<0.05) from other remaining samples. HS (E) with 80% substitution of PSC powder ranked the second higher of TDF (20.19%). Meanwhile, no significant different was observed in HS (C) (17.22%) and HS (D) (18.83%).

The high value of TDF content could be due to the fibre content from the PSC powder, herbal ingredients and coconut milk powder. On the other hand, fresh mushrooms are not rich in protein or fat but they contain appreciable amounts of dietary fibre (Manzi *et al*., 2001). In fact, coconut milk powder also rich in dietary fibre (Yalegama *et al*., 2013).

From the present study, PSC powder can be used to enhance the total dietary fibre of certain products which lack of fibre content since the PSC powder originally contains high amount of total dietary fibre

Table 3. Sensory analysis of HS added with different level of PSC

Attributes	Treatment					
	A (0%)	B (20%)	C (40%)	D (60%)	E (80%)	F (100%)
Aroma	5.58±1.236 [a]	4.79±1.32 [b]	4.47±1.12 [b]	4.88± 1.21[ab]	4.44± 1.05[b]	5.06± 1.24[ab]
Colour	5.03±1.17 [a]	5.08±1.18 [a]	5.03±1.23 [a]	4.94± 1.08[a]	5.23±1.05 [a]	5.23±1.25 [a]
Viscosity	4.38±1.21 [a]	4.14± 1.06[a]	4.17± 1.20[a]	4.47±1.15 [a]	4.50±1.19 [a]	4.59± 1.41[a]
Hotness	4.52±1.32 [a]	4.00±1.22 [a]	4.23± 1.32[a]	3.97± 1.08[a]	4.38±1.05 [a]	4.29± 1.29 [a]
Sourness	4.44± 1.06 [a]	3.73± 1.25[a]	3.67± 1.21[a]	3.76± 1.30[a]	3.76± 1.24 [a]	4.20± 1.25 [a]
Aftertaste	4.55± 1.32[a]	3.91±1.26 [a]	4.29±1.30[a]	3.97±1.15 [a]	3.85± 1.27 [a]	4.41± 1.22[a]
Overall Acceptability	5.11± 1.33[a]	4.00 ± 1.23[c]	4.17± 1.24[bc]	4.47± 1.23[bc]	4.25± 1.30[bc]	4.7± 1.15[ab]

(A=0% PSC, B=20% PSC, C= 40%PSC,D= 60% PSC, E=80% PSC, F=100%PSC)
(score 1= dislike extremely and score 7= like extremely)
[a-d] Mean values with different letters are statistically different ($p<0.05$)

(35.6%) (Wan Rosli *et al*., 2011). The same trends of increased TDF content were documented in other products such as in yeast bread incorporated with different levels of rice bran hemicelluloses B and also with rice bran insoluble fibre (Hu *et al*., 2009) and bread formulated with red and white bran (Sidhu *et al*., 1999).

Previously, coconut milk powder substituted foods are able to produce high amount of short chain fatty acids (butyric acid), show low glycemic index and maintain lower weight increase (Trinidad *et al*., 2006). Cell wall polysaccharides contain free polar groups, therefore they are hydrophilic. As a result of this they are able to bind water. The properties of water absorption and swelling capacity are very important factors when both health and processing aspects are concerned (Biswas *et al*., 2009).

The fibre content also was contributed from the herbal ingredients used in the formulations. Since ancient times, herbs and spices have been added to food to improve sensory properties and prolong their shelf life (Maria *et al*., 2008). Therefore, the increasing public awareness of dietary fibre potential health benefits has greatly encouraged food manufacturers to develop a wide range of fibre-enriched or fibre-fortified food products (Sloan, 2001:Ktenioudaki and Gallagher, 2012).

Similarly, ash and TDF increased significantly as well in the PSC-based HS. The increase in this nutrient could be probably due to their high nutritional quantities in oyster mushroom powder. Therefore, the consumption of HS added with PSC powder will enhance slightly protein intake including dietary fibre .

Sensory evaluation

Table 3 shows the values for all sensory attributes of HS added with PSC powder as judged by the untrained panels. They were staffs and students from the School of Health Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia. Sensory forms with seven point hedonic scales (1= dislike extremely and 7=like extremely) were used to differentiate the panel preferences in degree of liking. Six attributes evaluated were aroma, colour, viscosity, hotness, sourness, aftertaste and overall acceptability. HS was marinated with steamed chicken and served to the panels together with rice. Each sample was placed in a small sample container coded with three random permuted three digit numbers. There was no significant different ($p>0.05$) recorded in colour, viscosity, hotness, sourness, aftertaste and taste attributes in all different levels of PSC added in HS formulations. However, the colour and viscosity attributes showed higher values compared to the control sample.

The present result shows that panels prefer HS formulated with PSC powder in enhancing the colour and viscosity attributes. Moreover, there was significant different ($p<0.05$) recorded in both aroma and overall acceptability in all products. Interestingly, control samples (5.58) showed no significant different ($p>0.05$) with the HS (F)(5.06). In fact, control sample for aroma (5.58) recorded the highest value among other attributes and not significant different ($p>0.05$) with HS(F)(5.06). However, other samples showed significant different ($p<0.05$) with control samples and HS(F). For overall acceptability, the highest score was recorded in control sample (5.11) and not significant different ($p>0.05$) with HS(F)(4.7). However HS(C)(4.17) and HS(D)(4.47) showed no significant different ($p>0.05$) with HS(F) (4.7).

Among all HS samples, HS prepared without addition of PSC powder (control) received the highest scores for aroma (5.31), colour (5.45), viscosity (4.85), hotness (4.71), sourness (4.03), aftertaste (4.6), and overall acceptability (4.88). Even though control sample recorded the highest scores for viscosity, hotness, aftertaste, sourness and overall acceptability, but it was not significant different with other treatments.

HS(F) had received slightly higher ratings for colour and viscosity attributes compared to other treatments. To evaluate appearance of all products, attributes of colour brightness and viscosity were also considered. PSC powder addition caused an increase in lighter colour and decreased the brownish colour (data not shown).

Generally, HS added with PSC powder, panels prefer HS with 100% substitution since the main criteria for herbal paste is depend on the viscosity, taste and the colour of the product. For the aroma attributes, control, HS (F) was significant different from HS (B), HS (C) and HS (E), while for HS (D) and HS (F) was not significant different. It can be seen that the increment of the PSC powder will reduce the aroma of coconut milk powder. But, for the 100% substitution with PSC powder, the sensory panels accept the substitution of ingredients and the heat treatments may influence the acceptance of the products.

Conclusion

The various applications of nutritive food ingredients will make the food products become healthier for consumption of health conscious consumers. More value added efforts in terms of nutritional and dietary fibre can boost the products to fulfil the needs for the current demands of functional food. The substitution of PSC powder in HS formulations can be applied since the sensory panels unable to differentiate the control sample with PSC-based HS. In brief, the addition of PSC powder to replace coconut milk powder partially resulted in reducing fat, improving protein and dietary fibre while not jeopardizing sensorial attributes of HS products. HS formulated with more than 40% PSC powder is recommended since it has significant nutrients and palatably accepted by sensorial panellists.

Acknowledgements

Authors would like to thank Universiti Sains Malaysia and MARDI for the funding and the facilities provided. In addition, sincere appreciations are extended to all the staffs and seniors including Mr. Shazwan Zain, Mrs. Nurhanan, Mrs. Aishah and Miss Che Anis in Nutrition lab and Food Preparation lab in the School of Health Sciences, Health Campus, USM for their helps and guidance towards the success of this research.

References

Aishah, M. S. and Wan Rosli, W. I. 2013. The effect of addition of oyster mushroom *(Pleurotus sajor-caju)* on nutrient composition and sensory acceptation of selected wheat and rice-based products. International Food Research Journal 20(1): 183-188.

AOAC. 2000. Official Methods of Analysis of the Association of Official Agricultural Chemists. Association of Analytic Chemists, Washington, DC. Pp. 125-139.

Ares, G., Lareo, C. and Lema, P. 2007. Modified atmospheric packaging for the postharvest storage of mushrooms: a review. Fresh Produce 1: 32–40.

Biswas, A. K., Kumar, V., Bhosle, S., Sahoo, J. and Chatli, M. K. 2009. Dietary fibre as functional ingredients in meat products and their role in human health. International Journal of Livestock Production 2(4): 45–54.

Codex Alimentarius. 2010. Report of the 31st session of the Codex Committee on nutrition and foods for specific dietary uses. ALINORM 10/33/26.

Colak, A., Faiz, Z. and Sesli, E. 2009. Nutritional composition of some wild edible mushrooms. Turkish Journal of Biochemistry 34: 25–31.

Devece, C., Rodríguez-Lopez, J. N., Fenoll, J.T., Catala, J. M., De los Reyes, E. and Garcia-Canovas, F. 1999. Enzyme inactivation analysis for industrial blanching applications: comparison of microwave, conventional, and combination heat treatments on mushroom polyphenoloxidase activity. Journal of Agriculture and Food Chemistry 47(11): 4506-4511.

FAO. 1991. Protein Quality Evaluation. Rome: Food and Agricultural Organization of the United Nations.

Foschia, M., Peressini, D., Sensidoni, A. and Brennan, C. S. 2013. The effects of dietary fibre addition on the quality of common cereal products. Journal of Cereal Science 58: 216-227.

Hu, G., Huang, S., Cao, S. and Ma, Z. 2009. Effect of enrichment with hemicellulose from rice bran on chemical and functional properties of bread. Food Chemistry 115(3): 839-842.

Hyung Hong-Ga, Soo Kim-Young and Seoup Song-Geun. 2005. Effect of oyster mushroom powder on bread quality. Journal of Food Science and Nutrition 10: 214-218.

Khan, M.A. 2010. Nutritional composition and Hypocholesterolemic effect of mushroom: *Pleurotus sajor-caju* and Pleurotus florida: LAP Lambert Academic publishing Saarbrucken, Germany 1-11.

Ktenioudaki, A. and Gallagher, E. 2012. Recent advances in the development of high fibre baked products. Trends in Food Science and Technology 28: 4–14.

Manzi, P., Gambelli, L., Marconi, S., Vivanti, V. and Pizzoferrato, L. 1999. Nutrients in edible mushrooms: an inter-species comparative study. Food Chemistry 65: 477–482.

Manzi, P., Aguzzi, A. and Pizzoferrato, L. 2001. Nutritional value of mushrooms widely consumed in Italy. Food Chemistry 73(3): 321–325.

Maria, B., Signe, S. and Skredea, G. 2008. By-products from herbs essential oil production as ingredient in marinade for turkey thighs. LWT 41: 93–100.

Mattila, P., Suonpaa, K. and Piironen, V. 2000. Functional properties of edible mushrooms. Nutrition 16: 694–696.

McKee, L. H. and Latner, T. A. 2000. Under-utilized sources of dietary fibre: A review. Plant Food for Human Nutrition 55: 285–304.

Mohamed, A., Xu, J. and Singh, M. 2010. Yeast leavened banana-bread: Formulation, processing, colour and texture analysis. Food Chemistry 118(3): 620-626.

Mollet, B. and Rowland, I. 2002. Functional foods: at the frontier between food and pharma. Current Opinion in Biotechnology 13: 483-485.

Neothlings, U., Murphy, S. P., Wilkens, L. R., Henderson, B. E. and Kolonel, L. N. 2007. Flavonols and pancreatic cancer risk the multiethnic cohort study. American Journal of Epidemiology 166(8): 924-931.

Netzel, M., Netzel, G., Tian, Q., Schwartz, S. and Konczak, I. 2007. Native Australian fruits a novel source of antioxidants for food. Innovative Food Science and Emerging Technology 8: 339-346.

Okaka, J. C. and Okaka, A. N. C. 2005. Foods: Composition Spoilage, Shelf-life Extension. Academic Publishers. Enugu, Nigeria 20: 52-56.

Sidhu, J. S., Al-Hooti, S. N. and Al-Saqer, J. M. 1999. Effect of adding wheat bran and germ fractions on the chemical composition of high-fibre toast bread. Food Chemistry 67(4): 365-37.

Sloan, A. E. 2001. Dietary fibre moves back into mainstream. Food Technology 55(7):18-19.

Szabo, M. 2011. The challenges of "re-engaging with food" connection employment, household patterns and gender relations to convenience food consumption in North America. Food, Culture and Society 14(4): 547–566.

Takachi, R., Manami, I., Junko, I., Norie, K., Motoki, I. and Shizuka, S. 2008. Fruit and vegetable intake and risk of total cancer and cardiovascular disease Japan public health center- based prospective study. American Journal of Epidemiology 167(1): 59-70.

Trinidad, P., Mallillin, A. C., Valdez, D. H., Loyola, A. S., Askali-Merkardo, F. and Castillo, J. C. 2006. Dietary fibre from coconut flour: A functional food. Innovative Food Science and Engineering Technologies 7(309): 317-320.

Wan Rosli, W. I., Solihah, M. A., Aishah, M., Nik Fakurudin, N. A. and Mohsin, S. S. J. 2011. Colour, textural properties, cooking characteristics and fibre content of chicken patty added with oyster mushroom *(Pleurotus sajor-caju)*. International Food Research Journal 18: 612-618.

Wan Rosli, W. I., Nurhanan A. R. and Aishah, M. S. 2012. Effect of Partial Replacement of Wheat Flour with Oyster Mushroom *(Pleurotus sajor-caju)* Powder on Nutritional Composition and Sensory Properties of Butter Biscuit. Sains Malaysiana 41(12): 1565–1570.

Yalegama, L. L., Nedra Karunaratne, D., Sivakanesan, R. and Jayasekara, C. 2013. Chemical and functional properties of fibre concentrates obtained from by-products of coconut kernel. Food Chemistry 141: 124–130.