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Effect of *Pleurotus sajor-caju* addition on proximate compositions, total dietary fibre and acceptance of herbal seasoning stored at 0 and 6 months

(Kesan penambahan *Pleurotus sajor-caju* terhadap komposisi proksimat, jumlah serat diet dan penerimaan perencah herba disimpan pada 0 dan 6 bulan)

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Abstract
Convenience food is highly demanded in the current market. The purpose of the present study is to investigate the effect of *Pleurotus sajor-caju* (PSC) powder addition on proximate composition, total dietary fibre (TDF) and sensory acceptability of herbal seasoning (HS) stored at 0 and 6 months. A total of six formulations with different percentage of PSC powder at 0, 20, 40, 60, 80 and 100% were used. The addition of different percentage of PSC powder showed an increment in moisture, ash and protein content, while the fat content and carbohydrate were decreased during 0 month of storage. Addition of PSC powder resulted in significant higher (p <0.05) TDF content (15.0 – 23.0%) in 0 month. However, the content of TDF was reduced at 6 months (8.0 – 15.3%). The sensorial panels prefer HS formulated with PSC powder in enhancement of colour and viscosities attributes of the products for 0 month. However, after storage for 6 months, aroma and colour acceptance influenced the acceptability of HS. In brief, HS formulated with more than 80% PSC powder is recommended, since it has significant nutritional values and palatably accepted by sensorial panellists throughout the shelf life study conducted.

Keywords: herbal seasoning, *Pleurotus sajor-caju* powder (PSC), proximate compositions, total dietary fibre, sensory acceptability

Introduction

Present market trends are indicative of extensive growth in the demand for ready to cook (RTC) or ready to eat (RTE) convenience products manufactured from a wide variety of ingredients. This industry shows an extreme competitive one due to its simplicity, easy to prepare and yet flavourful and delicious. In modern lifestyle, there are families with less time available for cooking activity at home. There are different ranges of convenience products in the market such as herbal paste, tom yum paste, curry paste, ready to serve beriani food, instant noodle, instant soup, frozen food and fruit paste. Meanwhile, herbal seasoning (HS) is a local dish prepared using many common ingredients including coconut and culinary herbs leaves as key ingredients. All these ingredients will impart characteristic acceptance, colour, viscosity and nutritional properties of the finished products.

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Culinary herbs have a wide range of uses in food preparation, and the incorporation of mushroom powder with herbal ingredients will give some good combination to diversify the application of herbs and mushroom as well in RTE food products. Besides, the fruits and vegetables that are recommended at present as optimal sources of nutritious food, the supplementation of human diet with herbs, containing especially high amounts of compounds capable of deactivating free radicals (Madsen and Bertelsen 1995). Antiquity spices and herbs together with onion and garlic have been used throughout the world for flavouring and preserving food. In some cases, spices were used to mask off-flavour in products (Gonzalvez et al. 2008).

Interestingly, there are few ingredients that can be incorporated to enhance the nutritional value and acceptance of the HS. Oyster mushroom (*Pleurotus sajor-caju*) powder prepared from *Pleurotus* spp. is widely incorporated in food formulation. *Pleurotus* spp. is recognised as one of the commercially important edible mushrooms widely cultivated throughout the world. Furthermore, in agricultural aspect, mushrooms are known to convert lignocellulosic residues from agricultural forests into protein rich food (Khan et al. 2011; Michael et al. 2011).

Mushrooms were commonly classified as plants in the past and belong to fungi kingdom. They are edible and are rich in essential nutrients such as carbohydrates, proteins, vitamins, mineral, fat, fibres and various amino acids (Okwulehie and Odunze 2004). These mushroom claimed to be able to reduce the cholesterol level in blood (Pramanik et al. 2007) and prevent hyperlipidemia, and this ability is attributed to its low fat and high soluble fibre content (Schneider et al. 2011). Edible mushrooms are generally low in fat content and have high proportion of polyunsaturated fatty acids (72 – 85%) relative to total fat content, which are mainly linoleic acid. This is the reason why mushrooms are considered a health food (Chang and Mshigeni 2001). Edible mushrooms contain high amount of proteins, and are excellent source of fibres, vitamins and minerals (Manjunathan and Kaviyarasan 2011). Moreover, these edible mushrooms which is used in cooked or other processed forms are good dietary component for vegetarians and also suitable for diabetic and heart patients (Breene 1990) as they are good source s of phytosterols (Mattila et al. 2002).

Processing of mushroom is essential to the consumption and utilisation of edible mushrooms as it helps to preserve the nutrients and improves the taste, shelf life and utilisation efficiency. Recently, it was discovered that mushroom powder improved some nutrients content of butter biscuit (Wan Rosli et al. 2012) and rice based products (Aishah and Wan Rosli 2013).

Product deterioration mainly related to the physical, chemical and biological changes that occur throughout the food chain, and these changes might in time compromise nutritional, microbiological or sensory quality. In many products, changes in sensory characteristics occur largely before any risk to consumers' health is reached (Lawless and Heymann 2010). Therefore, shelf life of food products is important to be ensured, whereby a product could be stored until it becomes unacceptable from safety, nutritional, or sensory perspectives. The estimation of food products has become increasingly important in recent years due to technological developments and the increase in consumer interest in eating fresh, safe and high quality products. Thus, in order to extend commercialisation times to its maximum while assuring products' quality, food companies should rely on accurate methodologies for sensory shelf-life estimation.

Shelf-life is usually defined as the time during which a food product remain safe, comply with label declaration of nutritional data and retain desired sensory, chemical, physical and microbiological characteristics when stored under the recommended conditions (IFST 1993). Most common, a preservative is a naturally occurring or synthetically produced substances such as salt are added to product such as foods, pharmaceutical to prolong the shelf life of targeted products (Aubourg and Ugliano 2002). For economic value, finding unacceptable products within their shelf-life could diminish consumer confidence in the brand and in the store that sells them, leading consumers to not purchasing that particular brand again (Harcar and Karakaya 2005). Presently, herbal seasoning could not be permitted to add with food preservative since the food does not has specific regulation for the product. Malaysian Food Regulation 1985 and Food Act 1981, Regulation 395 (Foods not standardised elsewhere) has stated that food in form of paste is not permitted to include preservatives in the formulation. Thereby, the proper mechanisms must be done to preserve the food to be shelf stable at ambient temperature. Thus, some alternative method such as pasteurisation technique must be applied to prolong the shelf life of the product.

The purpose of the present study was to investigate the proximate compositions, total dietary fibre and the acceptance of HS using different ratios of PSC powder at 0 and 6 months of storage study. The finding from the present study is vital for embarkation of future investigations towards the investigation of antioxidant activities as well as the functional properties of the products.

Materials and methods

Preparation of PSC powder

The dried oyster mushroom samples (*Pleurotus sajor-caju, PSC*) were purchased from Anjaad^{TM} Sdn. Bhd. in Malacca, Malaysia. The mushroom undergone drying process namely Biodehydration system. This drying technique was developed by a local small and medium enterprises (SME) named Anjaad Manufacturing Industries. Samples were comprised of complete mushroom fruiting bodies (cap, gills, tubes, and stipe) of different sizes. The dried samples were then ground into powdered form using food grinder (National MX 895M), then kept in appropriate plastic bag prior in refrigerator for further analysis and processing.

Preparation of herbal seasoning

HS were prepared by using a mixture of locally available herbs, blended spices, mushroom powder and coconut powder as shown in *Table 1*. All local culinary herbs were purchased from local wet market. Coconut powder was substituted with PSC powder at the level of 0 (A), 20 (B), 40 (C), 60 (D), 80 (E) and 100 (F). Composite powders and other dry ingredients were mixed with culinary herbs in a jacketed kettle before water was added. The pH of the mixture was adjusted to less than 4.5 (4.00 – 4.30) with citric acid and the mixture was then heated to boiling. This is followed by hot filling into pasteurised bottles of 230 g followed by processing in boiling water until the temperature of the central region of the product reached 93 ^{o}C. The inner temperature of the HS was measured using type K thermocouple attached with data logger. The finished products were kept at room temperature until further analyses.

Table 1. Raw ingredients used in HS enriched with PSC powder

	PSC Powder Level (%)					
Ingredients	A	B	C	D	E	F
PSC	0	4	8	12	16	20
Coconut powder	20	16	12	8	4	0
Dried chili	1.6	1.6	1.6	1.6	1.6	1.6
Fresh 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
"Kerisik"	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

Proximate composition

Samples of *Pleurotus sajor-caju* enriched herbal seasonings were analysed for proximate composition (moisture, fat, ash, protein and carbohydrate) according to the Association of Official Analytical Chemists Methodology (AOAC 2000) with slight modifications. All the data are reported in dry matter content. The moisture content was determined by drying the samples in an oven at 105 °C until constant weight was achieved. Calculation of moisture was done by calculating the percentage by weight = (loss of weight in gram of the sample/weight in gram of the sample taken) ×100.

The crude protein content (N × 6.25) of the samples was measured by macro Kjedahl method. Calculation of protein was done by percentage = [{(ml HCI – ml HCI blank) × 14.008 × 0.1 N HCI × protein factor}/weight in g of the sample] × 100. The crude fat was determined by extracting a known weight of samples with petroleum ether, using a Soxhlet apparatus. Calculation of fat was based on percentage of fat in the sample = {weight of fat (gram)/weight in sample (gram)} × 100.

The ash content was determined by incineration at 600 ± 15 °C. Calculation of ash , was also based on percentage by weight = {weight of ash (gram)/weight of sample (gram)} × 100. Total carbohydrate was calculated by the difference: Available carbohydrate = 100 – (g moisture + g protein + g fat + g ash + g total dietary fiber).

Total dietary fibre

The content of total dietary fibre were determined using AOAC (2000) TDF 991.43 method. Sample (1 g) was homogenised in 20 ml of sodium phosphate buffer (0.1 M, pH 6.0) and was analysed for total dietary fibre. The samples were treated with thermo-stable α-amylase (Termamyl) to hydrolyse digestible starch, and then enzymatically digested with protease and amyloglucosidase to remove any digestible proteins. The filtrate was then subjected to alcohol precipitation and both the precipitates were dried overnight at 105 °C and were incinerated at 500 °C for 8 h. A control was performed following the same procedure. Total dietary fibre was then calculated.

Sensory evaluation

All herbal seasoning products used in the present study were added with different level of dried oyster mushroom powders (PSC) at 0 , 20, 40, 60, 80 and 100% were analysed using hedonic scale sensory method (Aminah 2000a; Aminah 2000b) for acceptability attributes. Sensory panels were randomly selected from University's staff and students for 50 untrained panels. 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. A total of seven attributes evaluated were colour, odour, viscosity, sourness, hotness, after taste and overall acceptability. Steamed chicken was marinated with HS 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.

Data analysis

Result was expressed as the mean ± standard deviation. Data obtained was statistically analysed using analysis of variance (ANOVA) and the Duncan Multiple range test by SPSS Predictive Analytics Software Statistics (PASW) version 19.0 (SPSS Inc, Chicago, Illinois) (SPSS Inc. 2009). All the measurement was carried out in triplicate (n = 3) analysis. Significant level established at $p \leq 0.05$.

Results and Discussion

The addition of PSC powder (0% to 100%) has significantly increased (p <0.05) the moisture, ash and protein content, while at the same time significant decreased (p <0.05) the fat and carbohydrate content of herbal seasoning (HS) stored at 0 month (*Table 2*). The moisture content was in the range of 58.76 – 62.69%. On the other hand, oyster mushroom powder contains 8 – 9% moisture (Khan 2010; Aisyah and Wan Rosli 2013). HS containing 40 – 100% of PSC powder resulted in higher moisture content compared to the control (58.76%). In general, the changes of moisture, ash, fat, protein and carbohydrate in proximate analysis occurred when PSC powder were added in the HS formulations. The increment in PSC powder increased the moisture content. The higher moisture content also could be related to water content and water holding capacity of PSC powder. It was from the sugar and dietary fibre available in PSC which may absorb large amount of water content (Mohamed et al. 2011). The findings were in line with the previous studies in the development of carbohydrate based food products (Wan Rosli and Aisyah 2012).

Fat content is the main issue arise by the consumers regarding the health problem and to get more nutritious products. Basically, HS had relatively high in fat content ranged from 8.16 – 13.82%, which is normal for all coconut based foods. As expected, the highest fat content was recorded in control samples (13.82%). Generally, the decreased in fat content was in parallel with the addition of PSC powder to substitute coconut milk powder in the formulations. The ash content was generally high in all the treatments at 0 month in the range of 14.27 – 15.72%. Moreover, ash content basically gives a rough idea about the mineral content in the product.

On the other hand, protein content indicated significant increased (p <0.05) about 36% increment in HS (F) than the control sample for 0 month. HS(F) (11.67%) was the highest and control sample had the lowest protein content (8.62%). To value add the protein content, the significant amount of PSC powder has to be introduced into the HS formulation. Interestingly, the positive increasing trend was observed in the protein content in line with the addition of PSC powder throughout the storage study. Aisyah and Wan Rosli (2013) also used PSC powder in formulation of porridge and bakeries products also getting the similar findings. The porridge added with 6% PSC powder increased significantly (p < 0.05) for protein (1.47g/100g) and ash content (1.23g/100g) compared to the control for protein (1.12g/100g) and ash content (0.7g/100g) respectively. On the other hand, carbohydrate content range from 43.75 – 47.71% and was reduced as a result of PSC powder addition in the product stored at 0 month. The highest carbohydrate content was recorded in control sample (45.36%) and significantly different (p <0.05) compared to HS(F) (40.13%). 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).

At 6 months storage study, HS recorded the significant different (p <0.05) in moisture, fat, ash, protein and carbohydrate content (*Table 2*). The lowest moisture recorded in HS (A)(61.50%), while HS (F) (65.39) had the highest moisture content. The fat content showed the decreasing trend as in 0 month in the range of 14.63% for control sample to 9.1% for HS (F) in line with the addition of PSC powder mainly due to the reduction of coconut milk powder used in the formulations.

Table 2. Proximate compositions of 0 and 6 months for HS incorporated with PSC powder

Proximate		PSC powder (%)					
	Month	0	20	40	60	80	100
Moisture	0	58.76 ± 2.25^{c}	60.4 ± 3.21^{bc}	61.08 ± 2.48^{ab}	62.49 ± 2.36^{a}	62.69 ± 3.35^{a}	62.09 ± 3.65^{ab}
	6	61.5 ± 2.85^{s}	62.7 ± 3.87^{r}	62.84 ± 0.85^{r}	62.76 ± 1.35^{r}	64.00 ± 2.84^{q}	65.39 ± 3.65^{p}
Fat	0	13.82 ± 0.84^{a}	13.2 ± 0.65^{b}	11.88 ± 0.65^{c}	10.03 ± 0.54^{d}	9.25 ± 0.95^{d}	8.16 ± 0.74^{e}
	6	14.63 ± 0.54^{p}	13.8 ± 0.45^{q}	12.21 ± 0.55^{r}	11.35 ± 0.45^{s}	10.01 ± 0.62^{t}	9.15 ± 0.41^{u}
Ash	0	14.27 ± 0.25^{c}	14.3 ± 0.28^{c}	14.40 ± 0.38^{c}	15.09 ± 0.45^{b}	15.11 ± 0.22^{b}	15.72 ± 0.18^{a}
	6	14.43 ± 0.25^{q}	14.49 ± 0.33^{q}	14.90 ± 0.38^{q}	15.1 ± 0.45^{p}	15.24 ± 0.25^{p}	15.65 ± 0.33^{p}
Protein	0	8.62 ± 0.25^{f}	9.15 ± 0.15^{e}	9.37 ± 0.28^{d}	10.74 ± 0.87^{c}	11.14 ± 0.25^{b}	11.67 ± 0.45^{a}
	6	6.92 ± 0.74^{s}	7.87 ± 0.25^{r}	8.25 ± 0.56^{q}	8.95 ± 0.44^{q}	9.40 ± 0.22^{p}	9.85 ± 0.24^{p}
Carbohydrate	0	45.36 ± 0.98^{a}	45.0 ± 0.88^{a}	45.03 ± 0.45^{a}	43.01 ± 0.25^{b}	41.71 ± 0.44^{c}	40.13 ± 0.56^{c}
	6	53.37 ± 0.25^{p}	51.57 ± 0.58^{q}	51.49 ± 0.77^{q}	51.14 ± 0.59^{q}	49.75 ± 0.43^{r}	47.65 ± 0.55^{s}

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)

Thus, the use of higher percentage of PSC powder showed significant decreasing (p <0.05) in total fat content in all samples analysed. The increasing value of total fat may be due to the incorporation of coconut crude "kerisik" at amount of 6% in all the formulations studied.

On the other side, the slight increase in ash content was recorded for 6 months stored product. There was an increasing trend recorded with the ash value in the range of 14.43% to 15.65%. Viuda-Martos et al. (2010) also reported the same finding of increasing ash content due to the added citrus fibre in sausage formulations. In fact, high amount of fibre from mushroom may be responsible for its relatively high amounts of ash (Cheung 1998).

The protein content for higher percentage of PSC powder (80% and 100% substitution) showed significantly different (p <0.05) compared to other samples at 6 months of storage study. HS (A) as control sample recorded the lowest content (6.92%) and HS (F) had the highest protein content throughout the storage study (9.85%).

For 6 months of storage, carbohydrate content was reduced as the increasing PSC powder formulated into the product. Obviously, all nutritional benefits are still available in the products within the 6 months of storage study. There was significantly different (p <0.05) recorded between HS (F)(47.65%) compared to HS (A)(53.37%). On the other aspects, *P. sajor-caju* is appreciated more than other *Pleurotus* species in aspect of delicious taste, low in fat, higher protein content and rich in minerals (calcium, phosphorus, iron) and vitamins (thiamin, riboflavin and niacin) (Manzi et al. 1999; Caglarirmak 2007).

Mushrooms relatively rich in nutritional properties, mainly the protein content and total dietary fibre (TDF).The nutritional quality of mushroom proteins are higher than protein source from plants. On the other hand, environmental factors, maturity index of fruiting bodies and the species are certainly affects the protein content of mushrooms (Colak et al. 2009). The increase in these chemical compositions could be probably due to their high quantities of nutritional composition in PSC powder. However, mushrooms are rich in lysine. Furthermore, the processing technology used significantly influenced the content of protein, ash and carbohydrate of mushrooms (Manzi et al. 2001). The fruiting bodies of mushroom consist about 5 to 15% by dry matter, high amount of protein, low fat content and source of B1, B2, C and D2 vitamins (Manzi et al. 1999; Mattila et al. 2000). It is speculated that the differences (p <0.05) obtained in crude protein between different formulations could be explained by the higher amount of moisture content that related to the addition of PSC powder in HS formulations.

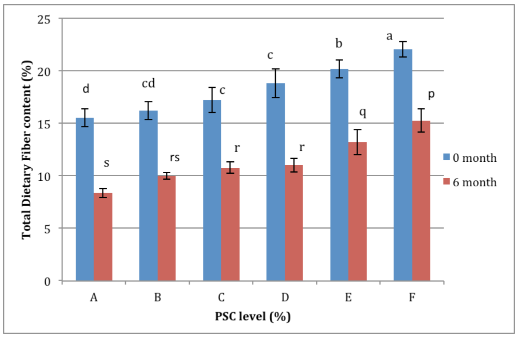
Total dietary fibre

Total dietary fibre content (TDF) of HS stored for 0 and 6 months is shown in *Figure 1*. Initially, the TDF concentrations of HS increased proportionally with the level of PSC powder addition in the HS formulations. All PSC- based HS recorded fibre content ranging from 15 – 23%. Furthermore, control sample (15.53%) showed the lowest content of TDF and was no significant different (p >0.05) with HS (B) (16.20%). Interestingly, the highest content of TDF was recorded in HS (F)(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 between HS (C) (17.22%) and HS (D) (18.83%).

Storage study showed that the TDF content was reduced in the range of 20 – 48% after 6 months of storage period (*Figure 1*). Basically, the reduction of TDF content was in line with 0 month which is control sample recorded the lowest content of TDF (8.35%). As expected, HS (F) recorded the highest content of TDF (15.25%) as previously recorded the highest TDF content in 0 month (22.02%) and significantly different (p <0.05) compared to other remaining HS. Nevertheless, HS (E) was 13.22 % of TDF content and significantly different (p <0.05) from HS (C) (10.75%) and HS (D) (11.01%)

Basically, cooking tended to increase starch, total dietary fibres and fat contents and to decrease chitin concentrations in all of the mushrooms. Crude fibre is a group of indigestible carbohydrates. In fact, mushrooms are regarded as a potential source of dietary fibres due to the presence of non-starch polysaccharides (Vetter 2007). From the present study, PSC powder can be used as a partially substitute for coconut milk powder and other related products based on coconut. It is because PSC powder originally contains high amount of TDF content (35.6%) (Wan Rosli et al. 2011). In HS formulations, other factors that contribute to the high content of dietary fibre could be due to the fibre content from herbal ingredients and coconut milk powder.

Figure 1. Total dietary fibre content of HS incorporated with PSC powder (0 and 6 months)



[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)

Moreover, many factors affect the dietary fibre content of HS products. Stirring during processing will open the fibre structure by mechanical shear, making free hydroxyl groups from cellulose available to bind with water (Sangnark and Noomhorm 2004).

During storage at 6 months, it seems that the TDF of shows decreasing trend. This could probably from the degradation of cell wall components such as cellulose, hemicellulose, pectin, and lignin, which is known to occur during storage (Khan 1996). Degradation of these polysaccharides in these tissues could have caused the apparent decrease in fibre over storage time. In the other hands, since ancient times, herbs and spices have been added to food to improve sensory properties and prolong shelf life (Maria et al. 2008). Therefore, the increasing public awareness of DF's 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).

Interestingly, many dietary fibres are used in food products such as oat in gluten free bread formulation (Sabanis et al. 2009), peach dietary fibre in jam (Grigelmo-Miguel and Martina-Belloso 1999) and oat in frozen dairy products (Soukoulis et al. 2009). Manzi et al. (2001) was reported that mushrooms not only rich in protein or fat but naturally contain appreciable amounts of dietary fibre.

Sensory evaluation

Table 3 shows the values for all attributes for 0 and 6 months evaluation used for HS added with PSC powder as given by the taste panellists of sensory evaluation. Basically, storage study of most food products is limited by changes in their sensory characteristics. There was no significant different (p >0.05) recorded in colour, viscosity, hotness, sourness and aftertaste attributes in all different levels of PSC added in HS formulations. The present result shows that panels prefer HS formulated with PSC powder in enhancing the colour and viscosity attributes. However, there was a significant different (p <0.05) recorded in aroma and overall acceptability in all the products. There might be due to the aroma of the PSC powder incorporated in the products. Interestingly, control samples (5.58) showed no significant different (p >0.05) with HS (F) (5.06). Generally, many factors can contribute to the acceptance of these edible mushrooms to be incorporated in HS such as good texture, flavour and their nutritional values (Diyabalanage et al. 2008). Moreover, control sample for aroma (5.58) recorded the highest value among other attributes. Basically, the deterioration in physical, chemical and biological changes might happen along the food chain which compromises the quality, acceptance and safety issues of the products. Therefore, the changes in sensory attributes can be clearly seen largely before any risk related to consumer's health is detected (Lawless and Heymann 2010).

For overall acceptability attribute, 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). On other hand, HS(B) (4.00) was insignificant different (p >0.05) with HS (C)(4.17) and HS (E) (4.25) and recorded the lowest acceptance by the panels. Among all HS samples, HS prepared without addition of PSC powder (control) received the highest scores for aroma (5.58), hotness (4.52), sourness (4.44), aftertaste (4.55), and overall acceptability (5.11). Even though control sample recorded the highest scores for hotness, sourness and aftertaste, it was not significantly different (p >0.05) with other treatments. To evaluate appearance of all products, attributes of colour brightness and viscosity were also considered. PSC addition caused an increased in lighter colour and decreased in brownish colour (*Table 4*).

There are two significant attributes and five non significant attributes found among the six samples of HS added with PSC powder in the sensory analysis for storage study at 6 months as shown in *Table 3*. Among all HS samples, HS prepared with no added 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 hotness and overall acceptability, it was not significant different with other treatments. There was no significant different for overall acceptability at 6 months of storage periods. The mean scores for overall acceptability were in the range of 4.38 – 4.88 and well accepted by the panelists. On the other aspect, the nutritional value, good flavour as well as distinctive texture are the main contributors to the acceptance of these edible mushrooms worldwide (Diyabalanage et al. 2008).

Generally, the PSC exerts unique taste and flavour when added in HS. In 0 month, panels more prefer HS with no substitution of PSC powder since the main criteria for paste is depend on the taste, viscosity and the appearance of the HS. However, HS (A) showed no significant different (p <0.05) compared to HS (F).

Table 3. Sensory analysis value of HS as influenced by the addition of different levels of PSC powder at 0 and 6 months (n = 50)

Attributes	Month	PSC powder level (%)					
		A	B	C	D	E	F
Aroma	0	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}
	6	5.31 ± 1.32^{p}	4.88 ± 1.31^{pq}	4.40 ± 1.22 ^{r}	4.65 ± 1.05 ^{r}	4.93 ± 1.25 ^{pq}	4.85 ± 1.21^{pq}
Colour	0	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}
	6	5.45 ± 1.15 ^{p}	5.33 ± 1.20^{pq}	4.85 ± 1.25 ^{r}	5.01 ± 1.10^{qr}	5.48 ± 1.09 ^{p}	5.21 ± 1.24 ^{pq}
Viscosity	0	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}
	6	4.85 ± 1.20 ^{p}	5.01 ± 1.02 ^{p}	4.76 ± 1.14^{p}	4.75 ± 1.25 ^{p}	4.91 ± 1.45^{p}	4.63 ± 1.25^{p}
Hotness	0	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}
	6	4.71 ± 1.25^{p}	4.66 ± 1.32 ^{p}	4.30 ± 1.05 ^{p}	4.41 ± 1.22^{p}	4.43 ± 1.21^{p}	4.20 ± 1.36 ^{p}
Sourness	0	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}
	6	4.03 ± 1.03 ^{p}	4.20 ± 1.35 ^{p}	3.96 ± 1.28^{p}	3.90 ± 1.29 ^{p}	4.13 ± 1.30^{p}	3.93 ±1.25 ^{p}
Aftertaste	0	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}
	6	4.6 ± 1.33 ^{p}	4.81 ± 1.23 ^{p}	5.35 ± 1.36^{p}	4.23 ± 1.23 ^{p}	4.48 ± 1.27^{p}	4.35 ± 1.32 ^{p}
Overall Acceptability	0	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}
	6	4.88 ± 1.16^{p}	4.88 ± 1.28^{p}	4.50 ± 1.05^{p}	4.41 ± 1.23^{p}	4.63 ± 1.30^{p}	4.38 ± 1.25^{p}

$^{a-e}$ Mean values in the same row 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)

Table 4. Colour value of HS using different level of PSC Powder

		PSC Powder Level (%)					
		A	B	C	D	E	F
L*	0	38.91 ± 0.32 ^{cd}	38.67 ± 0.24 ^{d}	39.15 ± 0.59 ^{bc}	39.17 ± 0.36 ^{ab}	39.56 ± 0.58 ^{a}	39.44 ± 0.22 ^{ab}
	6	43.17 ± 0.36 ^{r}	43.73 ± 0.42 ^{r}	43.77 ± 0.25 ^{r}	43.77 ± 0.15 ^{r}	44.33 ± 0.58 ^{q}	45.15 ± 0.60 ^{p}
a*	0	1.67 ± 0.24 ^{e}	1.81 ± 0.28 ^{d}	2.23 ± 0.19 ^{c}	2.23 ± 0.35 ^{c}	3.31 ± 0.15 ^{b}	3.43 ± 0.22 ^{a}
	6	6.77 ± 0.45 ^{s}	6.94 ± 0.58 ^{s}	7.09 ± 0.75 ^{s}	7.65 ± 0.25 ^{r}	8.48 ± 0.54 ^{q}	10.12 ± 0.64 ^{p}
b*	0	25.83 ± 0.33 ^{bc}	25.97 ± 0.52 ^{b}	24.58 ± 0.42 ^{d}	25.39 ± 0.28 ^{c}	27.24 ± 0.33 ^{a}	26.30 ± 0.45 ^{b}
	6	31.38 ± 0.25 ^{p}	28.78 ± 0.33 ^{q}	29.31 ± 0.68 ^{q}	32.26 ± 0.78 ^{p}	29.61 ± 0.85 ^{q}	31.50 ± 0.55 ^{p}

		A	B	C	D	E	F
L*	0	38.91± 0.32 ^{cd}	38.67 ± 0.24 ^{d}	39.15 ± 0.59 ^{bc}	39.17 ± 0.36 ^{ab}	39.56 ± 0.58 ^{a}	39.44 ± 0.22 ^{ab}
	6	43.17 ± 0.36 ^{c}	43.73 ± 0.42 ^{c}	43.77 ± 0.25 ^{c}	43.77 ± 0.15 ^{c}	44.33 ± 0.58 ^{b}	45.15 ± 0.60 ^{a}
a*	0	1.67 ± 0.24 ^{e}	1.81 ± 0.28 ^{d}	2.23 ± 0.19 ^{c}	2.23 ± 0.35 ^{c}	3.31 ± 0.15 ^{b}	3.43 ± 0.22 ^{a}
	6	6.77 ± 0.45 ^{d}	6.94 ± 0.58 ^{d}	7.09 ± 0.75 ^{d}	7.65 ± 0.25 ^{c}	8.48 ± 0.54 ^{b}	10.12 ± 0.64 ^{a}
b*	0	25.83 ± 0.33 ^{bc}	25.97 ± 0.52 ^{b}	24.58 ± 0.42 ^{d}	25.39 ± 0.28 ^{c}	27.24 ± 0.33 ^{a}	26.30 ± 0.45 ^{b}
	6	31.38 ± 0.25 ^{a}	28.78 ± 0.33 ^{b}	29.31 ± 0.68 ^{b}	32.26 ± 0.78 ^{a}	29.61 ± 0.85 ^{b}	31.50 ± 0.55 ^{a}

$^{a-e}$ Mean values in the same row 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)

However, at 6 months of storage study, there was no significant different (p >0.05) among all the treatments analysed in the range of 4.38 – 4.88. It can be seen that the increment level of the PSC powder in the HS formulation will reduce the aroma of coconut milk powder. Moreover, the application of various mushroom species in culinary around the world are related to their good flavour, taste and nutritious potential. Hence, for HS with more than 80% substitution of PSC powder, it is speculated that the sensory panels can accept the substitution of ingredients and the pasteurisation treatments given to the HS may influence the acceptance of the HS.

Conclusion

The investigation on proximate composition, total dietary fibre and sensory acceptance of the products are very paramount matter to consider before marketing the products. PSC powder was selected to substitute the coconut milk powder in reducing the fat content as well as increasing the protein content of the products. On the other hand, the substitution of 20% until 100% of PSC powder was significantly effective in improving the dietary fibre of the finished products. Moreover, PSC powder can be applied since the panels cannot differentiate the control sample with 100% substitution of coconut milk powder. Obviously, HS formulated with more than 80% PSC powder should be introduced in the market as one of promising products since it has significant nutrients and well accepted sensorial panellists over the 6 months of storage.

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Abstrak

Makanan konvenien kini mendapat permintaan tinggi di pasaran. Kajian ini dijalankan untuk mengkaji kesan penambahan *Pleurotus sajor-caju* (PSC) terhadap komposisi proksimat, jumlah serat diet (TDF) dan penerimaan sensori perencah herba yang disimpan pada bulan 0 dan 6. Enam formulasi pada tahap serbuk PSC yang berlainan iaitu 0, 20, 40, 60, 80 dan 100% digunakan. Penambahan peratusan berbeza serbuk PSC menunjukkan peningkatan kelembapan, abu dan protein manakala penurunan lemak dan karbohidrat untuk sampel yang disimpan pada bulan 0. Penambahan serbuk PSC menunjukkan nilai signifikan yang tinggi (p <0.05) pada nilai TDF (15.0 – 23.0%) pada 0 bulan penyimpanan. Namun, kandungan TDF menurun pada 6 bulan penyimpanan (8.0 – 15.3%). Panel nilai rasa memilih HS diformulasi dengan serbuk PSC kerana warna dan kepekatan yang boleh diterima pada bulan 0. Namun, selepas 6 bulan penyimpanan, bau dan warna mempengaruhi penerimaan pada HS ini. Secara ringkas, HS yang diformulasi melebihi 80% serbuk PSC dicadangkan kerana mempunyai kandungan pemakanan yang signifikan dan boleh diterima dari segi nilai rasa sepanjang kajian penyimpanan dijalankan.