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Effect of Different Ratios of Chicken Meat to Fresh Osyter Mushroom (*Pleurotus sajor-caju*) on the Physicochemical Properties and Sensory Acceptability of Sausages

Faridah Yahya[*], *Hun Tze Ting*
School of Fishery and Food Sciences, Universiti Malaysia Terengganu, Kuala Nerus, 21030 Terengganu, Malaysia
*) *Corresponding Author: faridahy@umt.edu.my*

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Abstract— **This study was aimed to determine the effect of different ratios of chicken meat to fresh oyster mushroom (*Pleurotus sajor-caju*) on the physicochemical properties and sensory acceptability of chicken sausages. Five formulations of sausages were prepared by different combinations of chicken meat with fresh oyster mushroom (100:0, 85: 15, 70: 30, 55: 45 and 40: 60). The physicochemical analyses included color profile, texture profile, calorie values, and proximate analysis were carried in triplicate while sensory acceptability of chicken sausages were evaluated using sensory acceptance test with 7-point of hedonic scale. Results indicated that the b* value as well as the hardness, springiness, cohesiveness, gumminess, and chewiness of sausages were significantly ($p<0.05$) reduced with the addition of fresh oyster mushroom. An increasing level of fresh oyster mushroom and reducing the chicken meat in the formulation were significantly ($p<0.05$) decreased the ash, crude fat and crude protein content but increased the moisture and crude fiber content of sausages. The carbohydrate content of sausages was insignificantly ($p>0.05$) influenced by different ratios of chicken meat to fresh oyster mushroom. This study also revealed that there were significant differences ($p<0.05$) between chicken sausages and mushroom-based sausages in all evaluated sensory attributes except for flavor and mouthfeel attributes. Chicken sausage with 45% of fresh oyster mushroom was the most acceptable formulation with providing fat-lowering and fiber-improving effects when compared to the control sausage.**

Keywords— ***chicken meat, oyster mushroom, physicochemical properties, sensory acceptability, sausages***

I. Introduction

The consumption behavior of consumers has been changed and more preferred towards the meat products [1]. Poultry meat was about 46.6 kg/capital consumption [2] and became the most consumed compared to the other selected livestock (beef, mutton, pork, and egg). Due to increased demand for chicken meat, the manufacturer processed the meat into various types of food products.

In Malaysia, the most popular processed food is sausages since 2001 [3]. The sausages became popular because of the first A & W fast food restaurant opened in Malaysia in the year of 1963 [4]. Sausages are made from the chopped and seasoned meat which usually in cylindrical shape [5]. The meat used can be either beef, pork, lamb or chicken. The meat will mix with seasonings such as spices, salt, preservatives, and food coloring. Then, the mixed ingredients are stuffed in tube-like shaped casing which either made from animal intestine or synthetic casing. The sausages can be eaten fresh, or after being cooked, fermented, smoked or cured.

However, consuming processed food frequently will bring unhealthy effects to human and at the same time, increase the risk of cancer [6]. Processed food normally contains high level of fat, sugar, and salt that will cause hypertension as a result of overweight or obesity if consuming excessively. Therefore, the manufacturers should take responsibility to develop healthier products by substituting non-meat ingredients such as fruits or vegetables into processed food.

Mushroom is the edible fungi which is the most popular to be consumed as the source of vegetables [1]. One of the commercially mushrooms is grey oyster mushroom (*Pleurotus sajor-caju*). The mushrooms contain high level of protein and carbohydrates, minerals such as calcium, phosphorus, and iron as well as vitamins such as thiamin, riboflavin, niacin and contains a small amount of fat [7]. Various types of dietary fiber have been used to increase the nutritional values of sausages as extensively studied previously. The addition of pumpkin fiber [8], Indian jujube pulp [9] and apple pomace powder [10] into sausages shown the improvement of dietary fiber content. The incorporation of capsicum, carrot, spinach, purple cabbage, and grey oyster mushroom were showed that the improvement of nutritional values of sausages [11]. In addition, the previous study also has been conducted by [1] about the effect of incorporation of oyster mushroom powder on the nutritional composition, β-glucan and textural properties of sausages. However, the development of the plant-based products has not been satisfied and appealed by the consumers in the recent market even though the product contained high nutritional values as compared to the meat products.

The addition of oyster mushroom into processed food is believed to be suitable for replacing meat due to its meaty taste [12] in order to improve the nutritional values. However, there is limited oyster mushroom-based products have been commercialized in the present market because the oyster mushroom is highly perishable. Besides, it is also lack of knowledge about the suitable amount of substitution of fresh oyster mushroom in chicken sausages to achieve the desired quality of a product. Therefore, this study was aimed to determine the effect of different ratios of chicken meat to fresh oyster mushroom on the physicochemical properties and sensory acceptability of sausages.

II. MATERIALS AND METHODS

Sample Preparation

Fresh grey oyster mushroom *(Pluerotus sajor-caju)* was purchased from Man Gedong Enterprise, Manir, Kuala Terengganu, Terengganu, Malaysia. While fresh chicken breast, vegetable oil, cornflour, garlic, red onion, salt, sugar, and black pepper powder were purchased from the local mini-market at Kuala Nerus, Terengganu. Egg white powder, isolated soy protein (ISP) and sodium trypolyphosphate were supplied by Eugene Chemical, Penang, Malaysia.

Sample formulation

There were four formulations of sausages made from 15%, 30%, 45% and 60 % of fresh oyster mushroom and one control sample (0% of fresh oyster mushroom). Except for chicken breast and fresh oyster mushroom, other ingredients have remained constant. The different proportions of chicken meat and fresh oyster mushroom used in the formulation is shown in Table 1.

The chicken breast was cut into small pieces and ground together with fresh oyster mushroom prior mixed with the remaining ingredients using a food processor. The batter was transferred into the sausage stuffer and stuffed into the cellulose casing (2.5 cm in diameter). The filled casing was twisted in every 15 cm long. Some tiny holes were poked on the sausage casing by using the sterilized needle to prevent high pressure formed inside the sausage casing. The sausages were cooked in medium stockpot at low heat after water started boiling for 3 min. The sausages were then cooled in ice bath about 15 min. The sausage casings were taken off. The sausages were then put into the plastic bags, sealed and stored in the freezer at -18 ºC for further analysis.

Physicochemical analysis

Before analysis, the sausages were thawed in the refrigerator overnight. Then, the thawed sausages were cooked in boiling water at 98 ºC for 3 min. The sausages were then cooled at room temperature for 15 min prior to analysis.

Table 1: Different proportions of chicken meat and fresh oyster mushroom for each formulation of sausages

Sausages	Weight (g)		Percentage (%)	
	Chicken Meat	Oyster mushroom	Chicken Meat	Oyster Mushroom
A	650.0	0.0	100	0
B	552.5	97.5	85	15
C	455.0	195.0	70	30
D	357.5	292.5	55	45
E	260.0	390.0	40	60

*Control sausage (A) contains 100% of chicken meat which referred to 650g from total ingredients of sausages.

All the analyses were conducted in triplicate on the physical properties of five different formulations of sausages included colour profile analysis, texture profile analysis, and calorie values determination. The sausages were sliced into small pieces (5 mm thick) prior to the determination of L*, a* and b* values by colorimeter (Minolta Chroma meter CR-210, Japan). The colorimeter was calibrated with a white plate tile (L* = + 97.83, a* = - 0.43, b* = + 1.98). The texture profile analysis was carried out using Texture Analyzer TA-XT 2 (Stable Micro System Ltd., UK). The sausages were cut horizontally into equal thickness of 1.5 cm. The sliced sample was placed centrally on the platform. The hardness, cohesiveness, springiness, gumminess, and chewiness of the sausages were measured using the compression plate (P/75). The texture analyzer was set as the following: load cell, 30 kg, pre-test speed and post-test speed, 3.00 mm/s, pre-fixed strain and 50% before second compression for 2 s. In the determination of calorie values, the sausages were homogenized by using mortar and pestle and dried in the convection oven at 60 ºC for 2 h. The sausages were then cooled down before submitted to bomb calorimeter (IKA calorimeter C2000 Basic, IKA-Werke, Germany). The proximate composition of sausages included moisture, ash, crude fat, protein, fiber and carbohydrate content was measured in triplicate [13].

Sensory evaluation

A sensory acceptance test with 7-point of hedonic scale was conducted by 35 randomly selected Universiti Malaysia Terengganu's student as panelists to determine the acceptability of sausages in terms of color, odor, texture, juiciness, flavor, mouthfeel and overall acceptability. Each sausage was cut in 3 cm long and 2.5 cm in diameter and stored in freezer at -18 ºC. Frozen sausages were then thawed in the refrigerator for 12 h. The thawed sausages were cooked in boiling water for 3 min and cooled in room temperature for 10 min. Each sausage was packed in a plastic bag and labeled with 3-digit random number. Five formulations of sausages were presented on the tray according to random permutation arrangement and distributed together with score sheet to each panelist.

Statistical analysis

All the data obtained were analyzed by using statistical software (Minitab Statistical Software version 18). Values of data were stated as mean ± standard deviation. One-way Analysis of Variance (ANOVA) with posthoc Fisher's LSD test was used to determine the significance results at $p<0.05$.

Physical properties of sausages

Table 2 shows the color profile of sausages prepared with different ratios of chicken meat to fresh oyster mushrooms. The L* value of sausages was ranged between 72.16 and 75.59. As can be seen in Table 2, reducing the level of chicken meat and increasing the level of fresh oyster mushroom were observed to reduce the lightness (L* value) of sausages. A similar finding also obtained by the previous studies done on other processed products treated with oyster mushroom included oyster mushroom incorporated in chicken patties [14] and the cinnamon biscuits treated with oyster mushroom [15]. This result might due to the original greyish-white color of fresh oyster mushroom [15] used in the formulation of sausages.

Table 2 also shows the control sausage, as well as sausages treated with 15% and 30% of fresh oyster mushroom, obtained negative a* values which were -0.28 ± 0.14, -0.17 ± 0.04 and -0.14 ± 0.06 respectively. These present results were against the previous study done by [11] on the incorporation of oyster mushroom in chicken sausages. The myoglobin and hemoglobin that provided red color to chicken breast meat would be denatured at temperature around 65 ºC to 80 ºC [16]. As a result, the muscle of chicken breast would be discolored and whiten which contributed to the negative a* result. In addition, [17] also stated that *Pleurotus sajor-caju* contained high amount of flavonoids and the flavonoid content increased proportionally with the level of oyster mushroom added in sausages. Therefore, the a* values of sausages has improved towards the positive values. The b* values were significantly different ($p<0.05$) among all chicken sausages (Table 2). This result was in good agreement with the study conducted by [11] on the inclusion of oyster mushroom powder in chicken sausages. The sausage without oyster mushroom obtained the highest b* value (14.66 ± 0.25). This result might due to the amount of chicken breast used. After cooking, the chicken breast meat was turned into opaque in color. Therefore, 100% of chicken meat used to prepare control sausage resulted high in b* value. When more chicken meat was replaced by fresh oyster mushroom, the intensity of grey colour was increased which could mask the yellowness of chicken meat and promote to reduce of b* value of sausages treated with fresh oyster mushroom.

III. RESULTS AND DISCUSSION

The calorie value of the control sample was significantly ($p<0.05$) different from the sausages treated with fresh oyster mushroom (Table 2). This finding was against the study by [1] who stated that the calories of chicken sausages were not significantly ($p>0.05$) affected with the addition of oyster mushroom powder. This might due to different methods used in calculating the energy values. The present study used a bomb calorimeter to determine the calorie value of sausages. The combustion of bomb calorimeter produced the caloric density which included the calories from both digestible and indigestible components such as fiber [18]. As can be seen in Fig. 1, sausages with 45% and 60% of oyster mushroom contained higher fiber content when compared to other formulations of sausages. Therefore, the high amount of fiber taken into account in the combustion of bomb calorimeter has led to increasing the calorie values obtained by the sausages with 45% of oyster mushroom (393.22 ± 14.78 kcal/100g) and 60% of oyster mushroom (343.10 ± 19.62 kcal/100g).

Table 2: Colour and calorie value (n=3) of sausages treated with different ratios of chicken meat to fresh oyster mushroom

Sausages	L*	a*	b*	Calories (kcal/100g)
A	75.59 ± 0.84^{a}	-0.28 ± 0.14^{d}	14.66 ± 0.25^{a}	296.79 ± 49.79^{c}
B	74.36 ± 1.65^{ab}	-0.17 ± 0.04^{cd}	13.78 ± 0.15^{b}	217.19 ± 1.44^{d}
C	74.80 ± 0.84^{ab}	-0.14 ± 0.06^{c}	12.85 ± 0.10^{c}	208.79 ± 8.30^{d}
D	73.09 ± 0.81^{bc}	0.11 ± 0.03^{b}	11.83 ± 0.13^{d}	393.22 ± 14.78^{a}
E	72.16 ± 0.63^{c}	0.26 ± 0.03^{a}	11.79 ± 0.16^{d}	343.10 ± 19.62^{b}

Mean values ± standard deviation with different superscript letters in the same column are significant different at $p<0.05$.

A-Sausage with 100% of chicken meat and 0% of fresh oyster mushroom
B-Sausage with 85% of chicken meat and 15% of fresh oyster mushroom
C-Sausage with 70% of chicken meat and 30% of fresh oyster mushroom
D-Sausage with 55% of chicken meat and 45% of fresh oyster mushroom

E-Sausage with 40% of chicken meat and 60% of fresh oyster mushroom

Table 3: Texture profile (n=3) of sausages treated with different ratios of chicken meat to fresh oyster mushroom

Sausages	Hardness (kg)	Springiness (mm)	Cohesiveness (ratio)	Gumminess (kg/mm^2)	Chewiness (kg/mm)
A	4.57 ± 0.28^{a}	9.12 ± 0.14^{a}	0.71 ± 0.01^{a}	3.24 ± 0.16^{a}	2.97 ± 0.11^{a}
B	1.96 ± 0.22^{b}	8.57 ± 0.05^{b}	0.52 ± 0.01^{b}	1.02 ± 0.12^{b}	0.87 ± 0.10^{b}
C	1.62 ± 0.02^{b}	8.43 ± 0.29^{b}	0.52 ± 0.01^{b}	0.83 ± 0.01^{c}	0.70 ± 0.02^{c}
D	1.13 ± 0.10^{c}	8.40 ± 0.03^{b}	0.50 ± 0.03^{bc}	0.57 ± 0.09^{d}	0.48 ± 0.07^{d}
E	0.83 ± 0.04^{c}	7.69 ± 0.22^{c}	0.47 ± 0.01^{c}	0.39 ± 0.03^{d}	0.30 ± 0.03^{e}

Mean values ± standard deviation with different superscript in the same column are significant different at $p<0.05$.

A-Sausage with 100% of chicken meat and 0% of fresh oyster mushroom
B-Sausage with 85% of chicken meat and 15% of fresh oyster mushroom
C-Sausage with 70% of chicken meat and 30% of fresh oyster mushroom
D-Sausage with 55% of chicken meat and 45% of fresh oyster mushroom
E-Sausage with 40% of chicken meat and 60% of fresh oyster mushroom

The textural properties of sausages prepared from different proportions of chicken meat to fresh oyster mushroom is shown in Table 3. The addition of fresh oyster mushroom was significantly ($p<0.05$) influenced the hardness, springiness, cohesiveness, gumminess, and chewiness of sausages. The hardness of sausages with addition of oyster mushroom (0.83 kg - 1.96 kg) was lower than the control sample (4.57 ± 0.28 kg). This result was in line with [11] on the inclusion of oyster mushroom powder in chicken sausages. The hardest control sample might due to the protein content of chicken meat (Table 4). The presence of myofibrillar protein in meat products might contribute the formation of gel [19]; [20]. The higher protein content provides the harder gel, thereby producing the highest hardness value to the sausages without addition of fresh oyster mushroom. The control sample (9.12 ± 0.14 mm) was springier than the mushroom-based sausages (7.69 mm - 8.51 mm). This result was well supported by [11] and [21] who stated that an increase of inulin and pectin, as well as oyster mushroom, added respectively into the batter has reduced the springiness of sausage. This was affected by the moisture content of oyster mushroom. As can be seen in Table 4, increasing the substitution of fresh oyster mushrooms into the sausages might increase the moisture content of sausages. According to [22], an increase in water content may promote to decrease the value of springiness. The oyster mushroom sausages (0.47 - 0.52 kg.s) exhibit lower degree of cohesiveness than the control (0.71 ± 0.01 kg. s). This result was in line with [1] in chicken frankfurters treated with *Pluerotus sajor-caju* powder. The decreased cohesiveness score of mushroom-based sausages was due to the protein content. There was a linear relationship between cohesiveness attribute and the protein content [23]. Since more oyster mushroom replaced with chicken meat in the sausages, there was less usage of chicken meat in making sausages and hence reducing the protein content (Table 5) and influenced the cohesiveness value of sausages. The control sample (3.24 ± 0.16 kg/mm^2) was gummier than the sausages incorporated with fresh oyster mushroom (0.39 - 1.02 kg/mm^2). The chewiness sausages formulated with oyster mushroom (0.30 - 0.87 kg/mm) was lower than the sausage without fresh oyster mushroom (2.97 ± 0.11 kg/mm). Gumminess and chewiness are secondary parameters that depend on the hardness of product [24]. Therefore, the gumminess and chewiness of sausages had similar trend with the hardness of sausages.

Chemical properties of sausages

The chemical composition of chicken sausages prepared with different ratios of chicken sausages to fresh oyster mushrooms is shown in Table 4. The range of moisture content of sausages was from 67.62% to 75.29%. As expected, the sausage without fresh oyster mushroom had the lowest moisture content (67.62 ± 0.33%) while the inclusion of 60% of fresh oyster mushroom into the sausages had the highest ones (75.29 ± 1.44%). The similar results were found by [14] and [25] in where the author and co-workers stated that the beef patty and chicken patty respectively containing 0% of oyster mushroom had the lowest moisture content. This was due to the functionality of dietary fiber contributed by oyster mushroom. Dietary fiber could improve the water holding capacity when it was added into meat products [26]. During cooking, the water released from the meat matrix would retain the dietary fiber of product [27]. The percentage of ash of chicken sausages was in the range of 1.41 - 2.29% (Table 4). There was significantly different ($p<0.05$) between ash content of sausages without fresh oyster mushroom and mushroom-based sausages. The

control sausage contained the highest percentage of ash (2.29 ± 0.13%). The ash content of sausage was decreased proportionally with the increasing level of oyster mushroom added into the sausage batter.

This trend was in line with the study done by [28] on the increment level of oyster mushroom (*Pleurotus sajor-caju*) powder in raw chicken patties as well as studied by [29] on the increasing level of carrot added into chicken sausages. According to [30], the protein content could positively influence the ash content. As can be seen in Table 4, the protein content of sausages was reduced with reduction of chicken meat and the addition of fresh oyster mushroom into sausages batter. This could be well explained that the declining trend of ash content with the increasing levels of oyster mushroom incorporated into the sausages.

The control sausage (0% of fresh oyster mushroom) showed the significantly ($p<0.05$) highest percentage of crude fat (4.43 ± 0.23 %) while the sausage incorporated with 60% of oyster mushroom had the lowest crude fat content (3.46 ± 0.36 %). The crude fat content was decreased proportionally with the increasing level of fresh oyster mushroom into the sausage batter. This finding was in agreement with [1] on the chicken frankfurters formulated with oyster mushroom (*Pleurotus sajor-caju*) powder. The reduction in the fat content of sausages formulated with fresh oyster mushroom might due to the lower fat content of oyster mushroom when compared to fat content of chicken. Every 100 g of ground *Pleurotus sajor-caju* contained 3.0 g of fat [28]. While the broiler chicken contained 11.1 g of fat in each 100 g of meat [31]. Therefore, the partial replacement of fresh oyster mushrooms into sausages has led to less utilization of chicken meat in order to reduce fat content in the sausages.

Moreover, the incorporation of fresh oyster mushroom has significantly ($p<0.05$) influenced the crude protein of sausages. Control (0% of fresh oyster mushroom) chicken sausages obtained the highest crude protein content (15.69 ± 2.59 %). The crude protein content of sausages was indirectly proportional to the inclusion levels of oyster mushroom (Table 4). This declining pattern was in agreement with the previous study done on the inclusion of oyster mushroom (*Pleurotus sajor-caju*) powder into the chicken frankfurters [1]. Similar results were also reported after the treatment of dietary fiber sources in sausages. As indicated by [32], the incorporation of capsicum has decreased the protein content of chicken sausages. Sausages treated with carrot also had lower protein content as compared to sausages with meat protein [29]. Reduction in protein content of sausages was related to low protein content of fresh oyster mushroom. Even though mushrooms contained a higher level of protein content in comparison to the majority of food such as milk, but it still cannot be comparable to the protein of animal meat [33].

Fig. 1 shows the crude fiber content of sausages prepared with different ratios of chicken sausages to fresh oyster mushroom powder. The sausage treated with fresh oyster mushroom had higher crude fiber content as compared to the control sample. This result was in line with the study done by [34] on the total dietary fiber of herbal seasoning formulated with *Pleurotus sajor-caju* as well as the study of [1] on the total dietary fiber of chicken frankfurters added with *Pleurotus sajor-caju*. The increasing trend of crude fiber content of sausages might be contributed by the fiber content of *Pleurotus sajor-caju*. The crude fiber content of fresh *Pleurotus sajor-caju* was considered higher (17.27 %) as compared to the crude fiber content of the broiler chicken breast (0.18%) [31]; [35].

As can be seen in Table 4, the carbohydrate content of all formulations of sausages was not significantly affected ($p>0.05$) by different ratios of chicken meat to fresh oyster mushroom and was in the range of 8.35% to 9.39%.

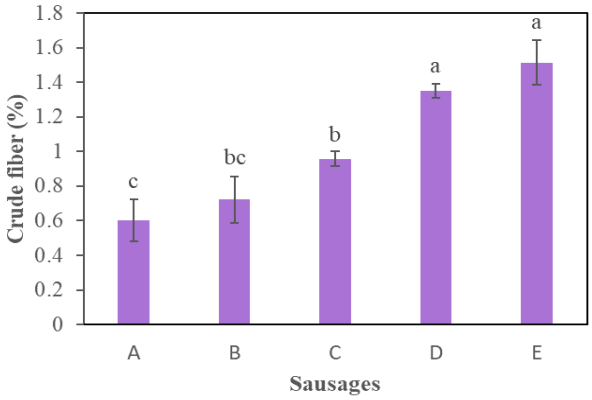

Figure 1: Crude fiber content (n = 2) of sausages treated with different ratios of chicken meat and oyster mushroom

Bars with different superscript letter are significantly different at $p< 0.05$

A-Sausage with 100% of chicken meat and 0% of fresh oyster mushroom
B-Sausage with 85% of chicken meat and 15% of fresh oyster mushroom
C-Sausage with 70% of chicken meat and 30% of fresh oyster mushroom
D-Sausage with 55% of chicken meat and 45% of fresh oyster mushroom
E-Sausage with 40% of chicken meat and 60% of fresh oyster mushroom

Table 4: Chemical composition (n=3) of sausages treated with different ratios of chicken meat and fresh oyster mushroom

Sausages	Moisture (%)	Ash (%)	Crude fat (%)	Crude protein (%)	Carbohydrates (%)
A	67.62±0.33^{d}	2.29±0.13^{a}	4.43±0.23^{a}	15.69±2.59^{a}	9.38±2.40^{a}
B	70.54±1.54^{c}	1.98±0.19^{b}	4.01±0.14^{a}	14.07±1.23^{ab}	8.68±2.81^{a}
C	72.36±1.71^{bc}	1.68± 0.18^{c}	3.95±0.83^{a}	11.87±1.30^{bc}	8.92±1.84^{a}
D	73.06±0.30^{ab}	1.59±0.12^{cd}	3.53±0.25^{b}	10.59 ±1.39^{c}	9.89±0.99^{a}
E	75.29±1.44^{a}	1.41± 0.07^{d}	3.46±0.36^{b}	9.19±1.08^{c}	9.14±1.09^{a}

Mean ± standard deviation values with different superscript letters in the same column are significantly different at $p<0.05$.

A-Sausage with 100% of chicken meat and 0% of fresh oyster mushroom
B-Sausage with 85% of chicken meat and 15% of fresh oyster mushroom
C-Sausage with 70% of chicken meat and 30% of fresh oyster mushroom
D-Sausage with 55% of chicken meat and 45% of fresh oyster mushroom
E-Sausage with 40% of chicken meat and 60% of fresh oyster mushrooms

Sensory acceptability of sausages

Table 5 shows the mean score of sensory acceptability of sausages incorporated with different ratios of chicken meat to fresh oyster mushrooms. The addition of fresh oyster mushroom into sausages seems to be acceptable by the panelists since all sausages formulations obtained mean scores above 4.00 in all evaluated sensory attributes. In addition, there were significant differences ($p<0.05$) between control sausages and mushroom-based sausages for all sensory attributes except for flavour and mouthfeel acceptability. The finding of colour and flavour mean score, as well as the overall acceptance, was in agreement with the studies done by the inclusion of oyster mushroom on chicken patties [25] and in beef patties [28].

The addition of fresh oyster mushroom also did not alter significantly ($p>0.05$) the odour acceptability of sausages which was well supported by [11] on the incorporation of oyster mushroom in sausages. Among the mushroom-based sausages, the sausages with 45% of oyster mushroom was rated the highest mean score for all of sensory attributes except for colour, juiciness and mouthfeel attributes although there was no significant difference ($p>0.05$) between all the mushroom-based sausages. Based on the texture attributes, the sausages added with fresh oyster mushroom have significantly ($p<0.05$) improved the acceptability towards the texture of sausages. This might be influenced by the biting texture of oyster mushroom [36]. Hence, the texture of mushroom-based sausages had a higher rating (4.63 – 4.91) than the control sausage (3.77 ± 1.48) as previously stated in Table 3. Furthermore, the replacement of chicken meat with fresh oyster mushroom was significantly ($p<0.05$) higher rating (4.11 - 5.31) in juiciness score than the sausages without oyster mushroom (3.43 ± 1.55). The chicken sausages became less acceptable in juiciness because of 100% of chicken breast utilized in preparing sausages. Chicken breast is categorized as lean meat that is less juicy [37]. In addition, the water holding capacity of oyster mushroom is responsible for retaining juiciness of sausages [11]. In summary, the panelists were unable to detect the differences of flavour and mouthfeel acceptability between sausage without oyster mushroom and sausages with addition of fresh oyster mushroom. Overall, the sausages with 45% of oyster mushroom obtained higher score than other formulations of sausages. This result also supported by [11] on acceptability of chicken sausages with 40% of oyster mushroom and [28] on chicken patties formulated with 50% of oyster mushroom and both products obtained high in sensory mean scores.

Table 5: Mean score (n=35) of sausages prepared with different ratios of chicken meat and fresh oyster mushroom

Attributes	Sausages				
	A	B	C	D	E
Colour	4.87 ± 1.53^{a}	4.57 ± 1.36^{ab}	4.63 ± 1.29^{ab}	4.46 ± 1.46^{ab}	4.20 ± 1.28^{b}
Odour	4.54 ± 1.09^{b}	5.14 ± 1.12^{a}	5.00 ± 1.35^{ab}	5.23 ± 1.22^{a}	4.80 ± 1.53^{ab}
Texture	3.77 ± 1.48^{b}	4.69 ± 1.30^{a}	4.71 ± 1.27^{a}	4.91 ± 1.40^{a}	4.63 ± 1.63^{a}
Juiciness	3.43 ± 1.55^{c}	4.11 ± 1.68^{b}	4.63 ± 1.22^{ab}	4.80 ± 1.53^{ab}	5.31 ± 1.51^{a}
Flavour	4.94 ± 1.31^{a}	4.74 ± 1.27^{a}	4.71 ± 1.32^{a}	5.09 ± 1.38^{a}	4.74 ± 1.54^{a}
Mouthfeel	4.60 ± 1.58^{a}	4.74 ± 1.36^{a}	5.03 ± 1.22^{a}	4.94 ± 1.33^{a}	4.71 ± 1.51^{a}
Overall acceptability	4.51 ± 1.58^{b}	4.86 ± 1.12^{ab}	4.94 ± 1.16^{ab}	5.20 ± 1.13^{a}	5.00 ± 1.39^{ab}

Mean score ± standard deviation with different superscript letter in the same row are significantly different at $p<0.05$
Score 1- Dislike extremely, score 7 – Like Extremely
A-Sausage with 100% of chicken meat and 0% of fresh oyster mushroom
B-Sausage with 85% of chicken meat and 15% of fresh oyster mushroom
C-Sausage with 70% of chicken meat and 30% of fresh oyster mushroom
D-Sausage with 55% of chicken meat and 45% of fresh oyster mushroom
E-Sausage with 40% of chicken meat and 60% of fresh oyster mushroom

CONCLUSION

In this study, the effect of different ratios of chicken meat to fresh oyster mushroom on the physicochemical properties and sensory acceptability have been successfully performed. An increasing level of fresh oyster mushroom and decreasing level of chicken meat were significantly ($p<0.05$) decreased the b* values and the degree of hardness, springiness, cohesiveness, gumminess, and chewiness of chicken sausages. The chemical composition of sausages except for carbohydrate content has significantly ($p<0.05$) affected by different levels incorporation of fresh oyster mushroom. Increased in addition of fresh oyster mushroom has increased the moisture content and crude fiber but reduced the ash content, crude fat and crude protein content of chicken sausages. In addition, the mean score of color, odor, texture and juiciness attributes were significantly ($p<0.05$) affected by the different ratios of chicken meat to fresh oyster mushroom. Sausages with 45% of fresh oyster mushrooms were the most acceptable with high mean score in odor, texture, flavor and overall acceptability.

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