

SENSORY EVALUATION OF MUSHROOM CHIPS AND MIXED SPICES COOKED BY OVEN DRYING METHOD

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ABSTRACT

Introduction: Chips are known to be one of the popular types of junk food that is highly consumed due to the appetizing appearance, aroma, taste and crispness. This research was carried out to develop the acceptable and healthy chips by using rice straw mushroom (*Volvariella volvacea*) with the mixture of different formulations of herbs and spices. The combination of rice straw mushroom (*Volvariella volvacea*) and mixture of herbs and spices known to produce better nutritional quality of chips and would be highly preferred in a matter of producing healthy snacks. **Methods:** The chips were developed and analyzed in term of sensory attributes and overall acceptance. The chips tested comprised of six different formulations which mainly formulated from mixture of herbs and spices which are cinnamon, ginger, onion, garlic, turmeric and holy basil. 35 panelists were randomly selected to evaluate the acceptability in term of sensory attributes of the newly developed chips of six different formulations. **Results:** Consequently, no significant difference in appearance and aroma of all chips formulations were observed, which made it equally acceptable to the panelists. The sensory evaluation also revealed significant difference ($p < 0.05$) in term of taste, crispness and overall acceptance of the chips. **Conclusions:** F6 was found to be highly acceptable with respect to sensory characteristics especially in term of appearance, taste and crispness. The outcome of this research can be used as valuable information for the development of healthy snacks as a good substitute to junk foods.

KEYWORDS: Rice straw mushroom, Herbs, Spices, Sensory evaluation, Chips, Oven drying method

INTRODUCTION

Junk food has been commonly consumed and most people opt for junk food such as salty chips or crisps as well as sweet and savory snacks (Boylan et al., 2017). Riaz (2016) revealed that higher proportion of working spouses, highly mobile populations, availability of junk foods and snacks in vending machines or convenience stores contribute to the increment of junk food consumptions. People of all ages demand for junk foods as it comes in variety of flavors and types, may be tasty and affordable as well. Although junk food is savory, it mainly contains higher level of fat, refined sugar, salts and food additives with low number of essential micronutrients needed in maintaining health (Rajkumaar and Preetha, 2016).

According to Marangoni et al., (2019), healthy snacks are snacks that can be easily digested and perceived good nutritional quality. Thus, the combination of mushroom, herbs and spices may be one of the best ways in a matter of producing healthy snacks. Mushrooms are considered as one of the prime functional food for human consumption since centuries ago (Khan et al., 2016). In the market, most of the mushroom based junk foods, usually mushroom chips or crisps are from Shiitake mushroom (*Lentinula edodes*) type. Shiitake mushroom is very well-known in East Asian countries. However, there is still no products from rice straw mushroom (*Volvariella volvacea*) based on the current market.

Rice straw mushroom is known to be one of a popular edible mushroom type due to nice aroma, flavor and taste which make it palatable. This specific type of mushroom can be found in all rice growing countries especially in tropical and sub-tropical region (Chang and Yau, 1971). Like any other mushrooms, rice straw mushroom possesses many health benefits. Ancient Chinese used this type of mushroom in alleviating heat stroke, lowering body temperature, enhancing milk production in lactating mother as well as other health problems (Chandra and Chaubey, 2017). Moreover, Lee and Chang (1975) stated that rice straw mushroom has been found to have higher nutritional value, in comparison to white cultivated mushroom type.

Apart from that, herbs and spices has been widely used in cooking as natural flavoring agent and gives pleasant aroma to the foods. Tapsell et al., (2006) mentioned that herbs and spices can be a good option in replacing seasoning agent such as sugar, salt, or saturated fat. Other than for cooking use, the effectiveness of herbs and spices in medical treatment made it still be one of the popular alternatives for treatment of certain diseases in the modern world. Surh et al., (2005) stated that herbs and spices are found to develop protection against oxidative stress and inflammation due to obesity problems.

In this study, we aimed to develop a healthy snack substitutes for people who always opt for junk foods by producing chips from rice straw mushroom with a combination of selected herbs and spices. Thus, the use of rice straw mushroom that is a good source of fiber and packs with nutrients with mixture of herbs and spices which known to be a good source of antioxidants in chips production is one of the best ways to prepare healthy snacks version. With that, people can enjoy healthier snack compared to the one they keep on consuming today.

METHODS

Sample size

In total, 35 IIUM Kuantan undergraduate students at the age of 19-25 years were randomly selected as panelists for the sensory evaluation of rice straw mushroom mixed with herbs and spices-based chips. Panelists were male and female who were free from any health conditions on the day of sensory testing. Then, potential panelists were free from any allergies towards any food products and able to evaluate the characteristics of the food product consists of taste, aroma, appearance and crunchiness. Details regarding the panelists were obtained through consent forms which was distributed prior to the recruitment for the sensory evaluation/testing.

Chips preparation

In this chips production, rice straw mushroom (*Volvariella volvacea*) was used as the main ingredient. There were six formulation of chips in which using different types of mixed herbs and spices as shown in the Table I. In order to prepare the chips, fresh rice straw mushroom from the farm were provided by the collaborator for the success of this project. Grounded spices and herbs were purchased from supermarket. In a food processor, the chips ingredients which are dried mushrooms were mixed with chickpea flour, water as well as mixture of herbs and spices as shown in Table I. Paprika and salt were also added to enhance the taste. After that, the mixture was grinded until the finest consistency of dough were achieved. Then, the chips dough was rolled into thin layer before shaped into desired chips shape. The chips that has been shaped were distributed uniformly as a thin layer on stainless steel tray which has been glazed with some cooking oil. The chips were prepared by using oven drying method at the temperature of 180°C for 5 minutes. Preparation of chips for each formulation were repeated with the same steps.

Sensory evaluation

Sensory evaluation was performed to test for the chips' acceptability and best chips formulation was determined based on the sensory evaluation score. 9-point hedonic scale rating was used in determining the degree of acceptability of the chips and 5 parameters were assessed which are appearance, aroma, taste, crispness and overall acceptance. All panelists were provided with 6 chips according to 6 different formulations in the individual testing booths under white lighting. In the testing booths, all panelists were provided with the sensory evaluation forms in order to assess for their acceptance on the chips tested. All panelists were needed to test and evaluate all 6 formulations on the scale provided in the sensory evaluation form. Water were provided to rinse out their mouth between each formulation's tasting.

Table 1 Ingredients used in chips preparation

Ingredient	FORMULATION					
	F1	F2	F3	F4	F5	F6
Mushroom (g)	120	120	120	120	120	120
Chickpea flour (g)	100	100	100	100	100	100
Cinnamon (g)	5	5	5	5	5	5
Garlic (g)	5	-	5	5	5	5
Onion (g)	5	5	-	5	5	5
Ginger (g)	5	5	5	-	5	5
Holy Basil (g)	5	5	5	5	-	5
Turmeric (g)	5	5	5	5	5	-
Paprika (g)	5	5	5	5	5	5
Salt (g)	5	5	5	5	5	5
Water (ml)	60	60	60	60	60	60

Statistical analysis

All data of sensory evaluation were collected and analyzed using statistical analysis with the help of IBM SPSS version 21. Analysis of variance (ANOVA) was used in determining the significance of difference of the results. Then, Tukey HSD and Post-Hoc test was used for result with significant difference to determine where the differences came from between the groups. The difference in the mean value were recorded as significant at 95% confidence interval ($p < 0.05$).

RESULTS

Sensory evaluation of mushroom chips

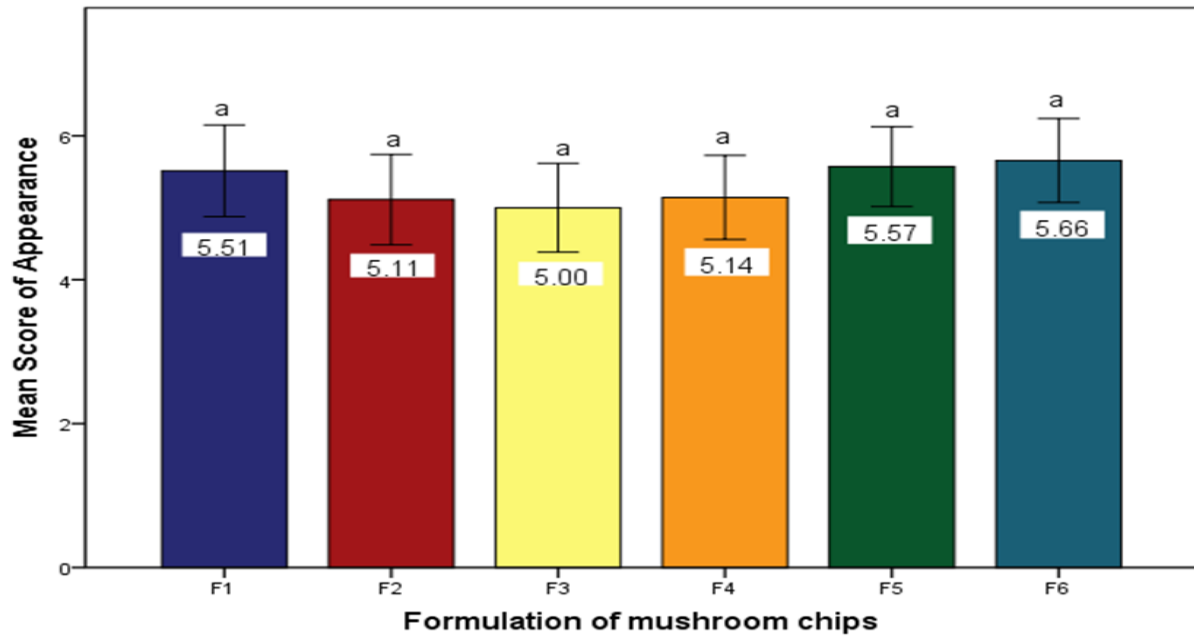
There was no significant difference in acceptability of appearance and aroma of the mushroom chips as the p-values are of 0.489 and 0.779 respectively. Thus, the appearance and aroma of the chips are equally acceptable to the panelists. Nevertheless, the table displayed that the acceptability of the other 3 sensory characteristics which are taste, crispness and overall acceptance differ significantly between the formulations in which $p < 0.05$. Thus, null hypothesis was accepted. Overall, formulation 6 (F6) was the highly acceptable formulation followed by formulation 4 (F4), meanwhile formulation 5 (F5) was the least acceptable formulation. As some of the results obtained are significant in which $p < 0.05$, Tukey HSD and Post-Hoc Test were conducted in order to confirm the difference that occur between the formulations.

Table 2 Comparison of the Mean Values on Acceptability of the Sensory Criteria between Formulations

Criteria	Mean value \pm SD						<i>p</i> -value
	F1	F2	F3	F4	F5	F6	
Appearance	5.51 \pm 1.85	5.11 \pm 1.82	5.00 \pm 1.78	5.14 \pm 1.70	5.57 \pm 1.61	5.66 \pm 1.70	0.489
Aroma	5.46 \pm 1.76	5.43 \pm 1.72	5.11 \pm 1.69	5.09 \pm 1.72	4.94 \pm 1.70	5.20 \pm 1.61	0.779
Taste	3.97 \pm 1.82	4.43 \pm 1.38	4.49 \pm 1.69	4.63 \pm 1.78	3.69 \pm 1.69	5.31 \pm 1.84	0.003
Crispness	3.00 \pm 1.73	4.34 \pm 2.11	5.14 \pm 1.99	4.17 \pm 2.50	3.20 \pm 1.62	5.89 \pm 2.10	0.000
Overall Acceptance	4.17 \pm 1.74	4.51 \pm 1.38	4.71 \pm 1.56	5.06 \pm 1.73	4.11 \pm 1.41	5.83 \pm 1.58	0.000

Appearance

According to Figure 1, the mean acceptance in term of appearance of the mushroom chips shows no significant difference. It can be seen clearly as the mean value of all formulations were close to each other. It can be inferring that the appearance of chips is equally acceptable to the panelists.

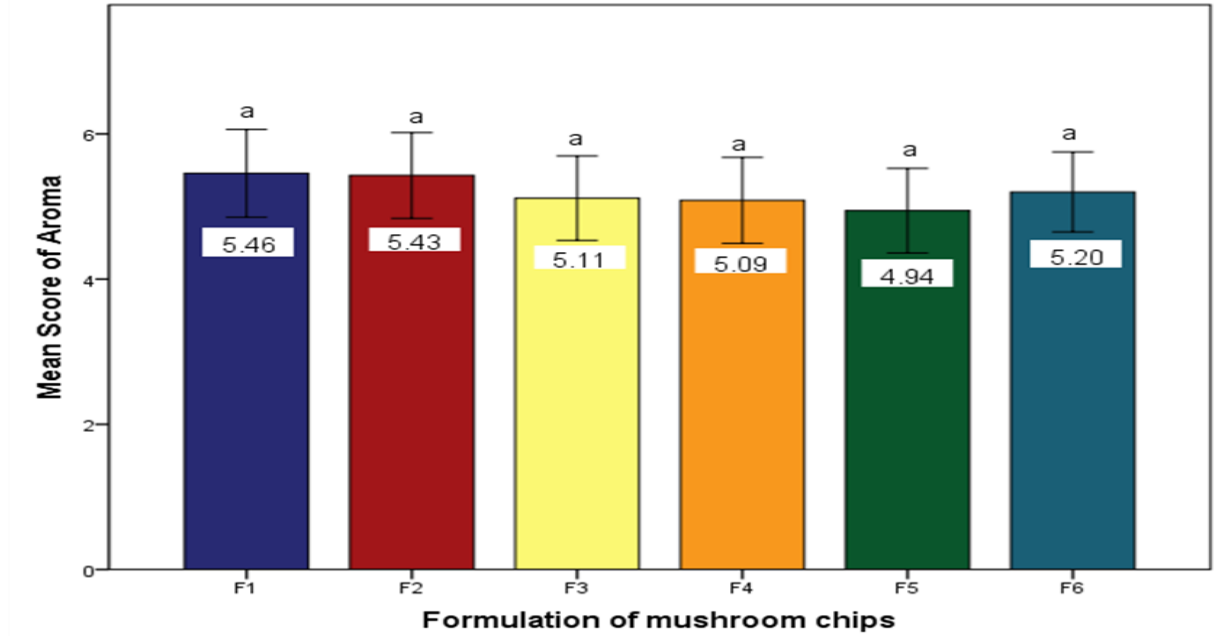


*Note: The data bar with similar superscript indicates no significant difference

Figure 1. Graph of the Mean Value for Appearance According to Six Different Formulations

Aroma

Based on the results displayed in Figure 2, the mean acceptance of the aroma of the mushroom chips revealed that there was no difference in the aroma of all six formulations. This shows that the aroma of chips in all formulations are equally acceptable to the panelists.

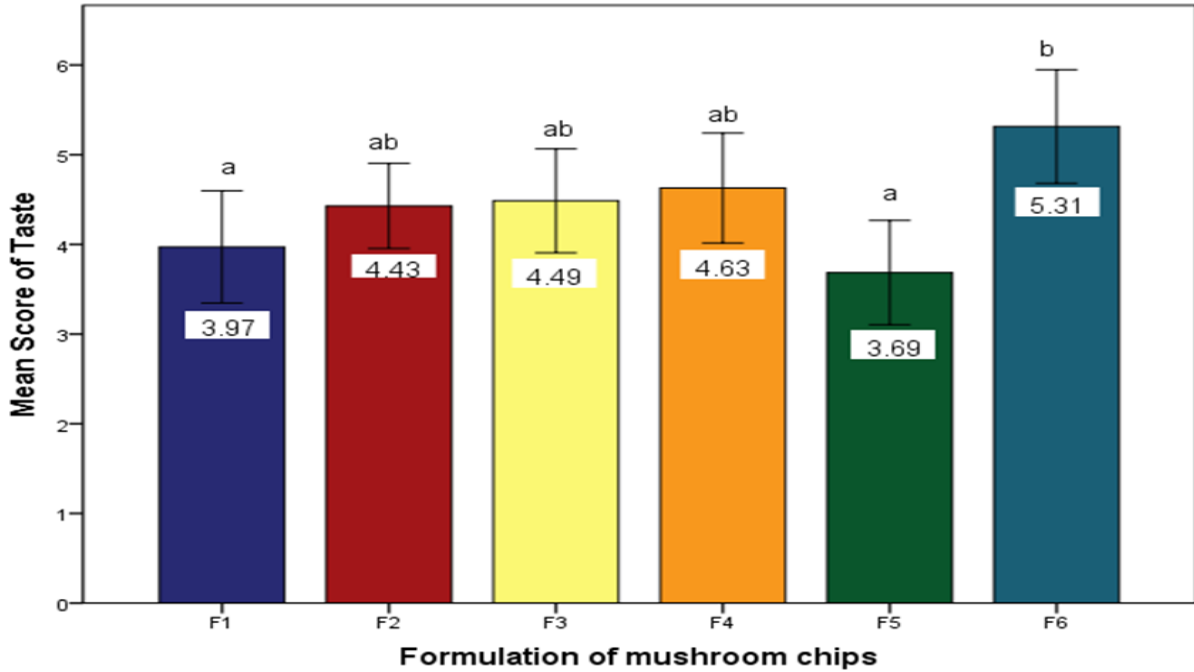


*Note: The data bar with similar superscript indicates no significant difference

Figure 2. Graph of the Mean Value for Aroma According to Six Different Formulations

Taste

For the taste acceptability of mushroom chips, Figure 3 shows that formulation used in formulation 5 (F5) and formulation 1 (F1) were the least accepted with the mean score of 3.69 and 3.97 respectively. Formulation used in formulation 6 (F6) was highly acceptable taste with mean score of 5.31. After the Post-Hoc test, it was found that F1 with F6 were significantly different, similar to F5 with F6 which show significant difference from each other. Overall, it can be concluded that the taste of chips using F6 is the most acceptable meanwhile the taste of chips using F5 is the least acceptable, followed by F1.

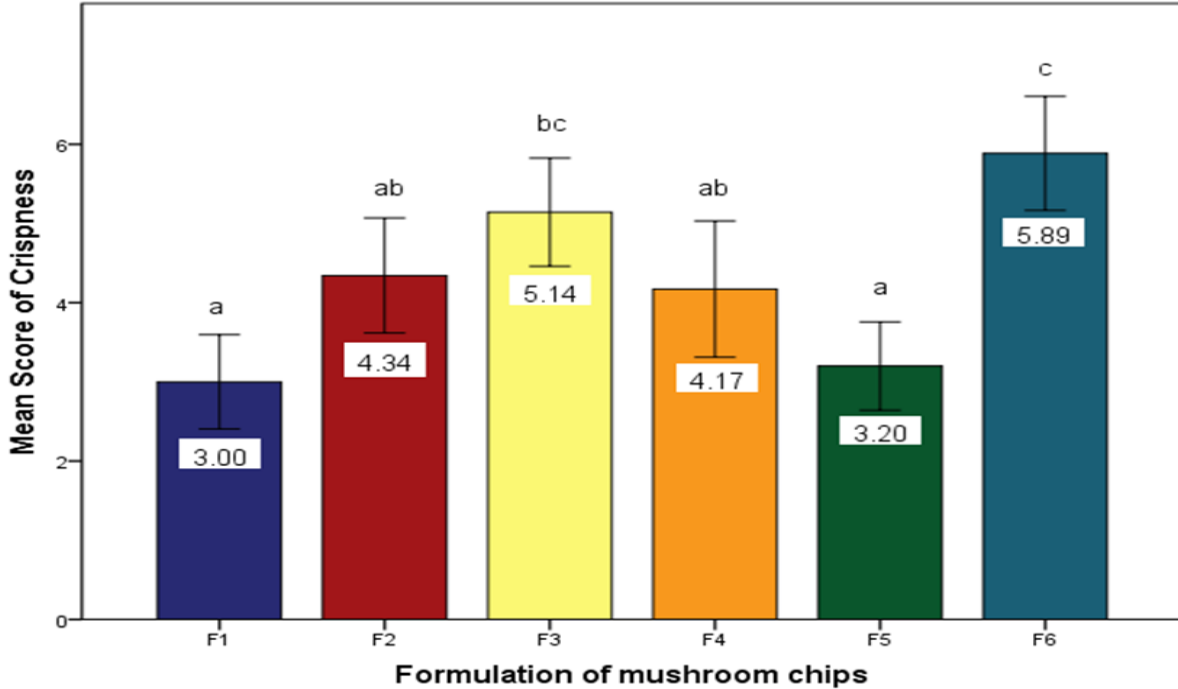


*Note: The data bars with different superscripts are significantly different at $p < 0.05$

Figure 3. Graph of the Mean Value for Taste According to Six Different Formulations

Crispness

According to the result shown in the Figure 4 indicates that there was significant difference in term of crispness of the chips between different formulations. It was revealed that the crispness of chips using formulation 6 (F6) was highly acceptable to the panelists while chips using formulation 1 (F1) was least accepted by the panelists in term of crispness. It was also found that there was significant difference between F1 and F3, together with F2 and F6, F3 and F5 as well as F4 and F6.

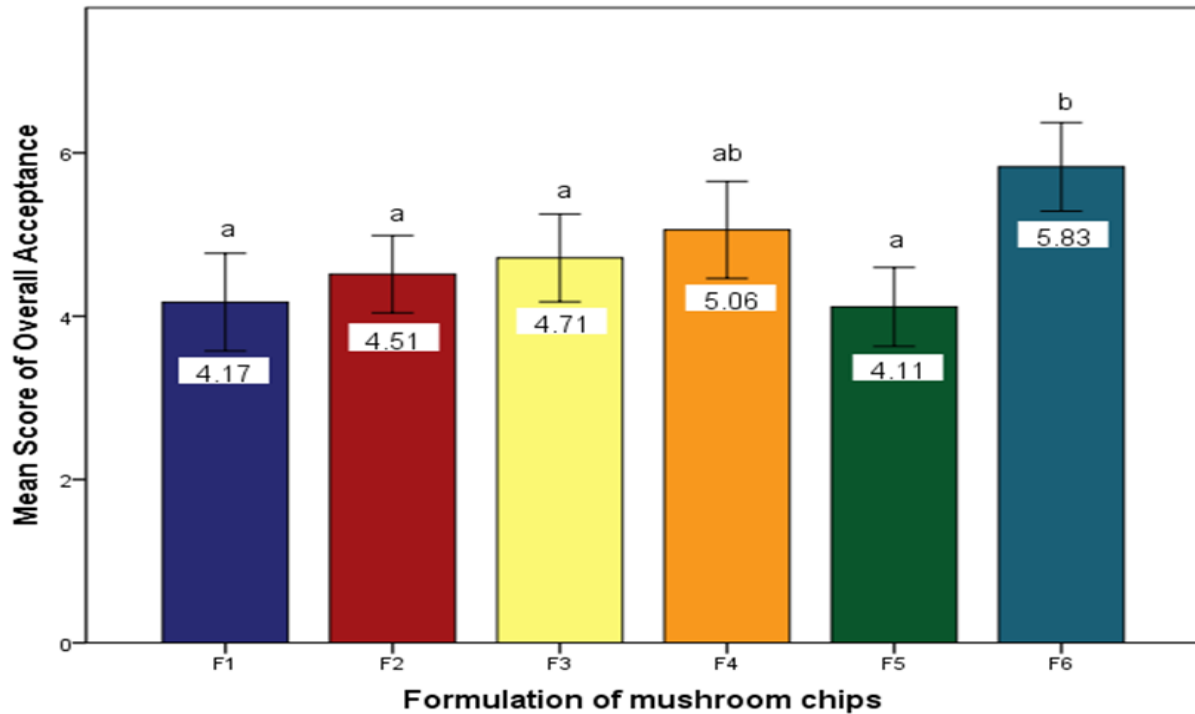


*Note: The data bars with different superscripts are significantly different at $p < 0.05$

Figure 4. Graph of the Mean Value for Crispness According to Six Different Formulations

Overall Acceptance

The overall acceptance of the mushroom chips for each formulations differ significantly ($P < 0.05$) from each other. The difference can be seen clearly in Figure 5 which revealed formulation 6 (F6) is the most acceptable formulations with the highest mean score of 5.83. Formulation 5 (F5) was the least acceptable chips followed by formulation 1 (F1) with mean score of 4.11 and 4.17 respectively. From the graph, it is revealed that there is no difference in term of overall acceptance between F6 and F4 as they shared the same superscript. However, F6 differ significantly from F5. The F6 was found to be the most acceptable formulation for the mushroom chips.



*Note: The data bars with different superscripts are significantly different at $p < 0.05$

Figure 5. Graph of the Mean Value for Overall Acceptance According to Six Different Formulations

DISCUSSION

This experimental work on sensory evaluation of rice straw mushroom chips mixed with herbs and spices has shown that there was difference in panelists' acceptance on the taste, crispness, overall acceptance while appearance and aroma of chips were equally acceptable. Choi (2013) stated that color is known as one of the important attributes as it can trigger the desirability and expectation of the mind on the taste of a food product. Cinnamon powder purchased was of brown color, turmeric powder perceived a golden yellow color and holy basil powder was of dark green color. Onion powder, garlic powder and ginger powder were observed to be within the same range of color which is light beige to pale yellow. From the observation, the brown color of cinnamon powder was visually overpowered the other colors of herbs and spices. Overall, the chips color for all formulations were not differ from each other as cinnamon powder was perceived as controlled in all six formulations. Apart from that, cooking by oven drying method results in browning of the chips surface (Oluwole et al., 2014).

Moreover, the aroma of the chips for all formulations were also equally acceptable. Most of the herbs and spices used in this study known to have pungent, spicy smell such as turmeric, ginger, garlic, cinnamon and holy basil while onion has a little sweet-spicy smell. Thus, the

mixture of the herbs and spices made the chips produced using all six formulations were of about the same aroma. Gupta (2010) stated that that herbs and spices are used in cooking and condiments as odor-stimulating agent.

Results shown in Figure 3 display that there is significant difference in term of the chips taste for each formulation. It is revealed that formulation 5 (F5), with the absence of holy basil were the least acceptable formulations in term of taste, followed by formulation 1 (F1) which consists of all types of herbs and spices used in this study. Comparing these two formulations, the presence of holy basil in the chips might increase its palatability as it gives a sweet-minty taste to the chips. Apart from that, formulation 6 (F6), with the absence of turmeric was found to have the most acceptable taste compared to other formulations. From the results, it is assumed that most of the panelists dislike the taste of turmeric as it contributed to bitter aftertaste. Plotto (2004) disclosed that turmeric is ideal to be used as food colorant than as flavoring agent due to the bitter taste. Tunick et al., (2013) proclaimed that crispness of a food product may influence taste perception. In addition, the aroma of food products can also affect the taste perception as it contributes to 75% of the taste impression based on Choi (2013).

Furthermore, crispness is also known as an important sensory characteristic in chips production and served as primary attribute in determining chips quality (Kwak et al., 2019). Figure 4 shows that there was significant difference in term of chips as it was hard to retain the thickness of the chips within the same thickness using the dough roller. Thus, the thickness of chips for every formulation might perceived slight difference. Moreover, Tuta and Palazoglu (2017) stated that chips cooked by oven drying method has brittle and less flexible texture.

The mushroom chips were also be tested in term of overall acceptance. It takes into consideration of all sensory characteristics tested in this study. Choi (2013) stated that the color of food alone gives a huge impact on the acceptability of a food product before the other sensory attributes. From the results in Figure 5, chips prepared using formulation 6 (F6) has the highest acceptance rate compared to chips prepared using other formulations. Thus, F6 is found to be the best formulation for this study as it also scored the highest in most sensory characteristics tested which are appearance, taste and crispness. The mean value of overall acceptance for F6 is 5.83 which indicate "Like slightly" in the 9-point hedonic scale rating.

Apart from that, having a right environment when conducting food tasting and sensory evaluation are important (Carpenter, Lyon and Hasdell, 2000). The place for sensory evaluation should be free from distractions such as lighting, noise, outside odors, excessive heat or cold as well as other discomfort as it can influence the panelists' decision makings. However, the sensory evaluation for the rice straw mushroom chips were conducted at 3 different places due to some limitations. Choi (2013) suggested a reasonable number of samples are from two to four panelists a time in order to avoid misinterpretation of sensory acceptance. Nonetheless, the time and number of panelists tested at one time also cannot be fixed due to time constraint. Hence, this

situation may negatively influence the results of sensory evaluation. Other than that, strong emotions or psychological factors may also affect the panelists' decision makings (Creed, 1998).

CONCLUSIONS

This research revealed that the appearance and aroma of the chips between the six formulations were equally accepted by the panelists. Nonetheless, it perceived significant difference in term of taste, crispness and overall acceptance of the chips. In a matter of fact, it was found that F6 is the most preferred formulation in which appearance, taste and crispness of the chips were highly accepted by panelists. However, it is agreed that further study are needed in term of improving the recipe of the chips to increase the scale of consumers' acceptability as well as its potential to be commercialized.

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