

AN ASSESMENT OF ACCEPTIBILTLY OF SENSORY ATTRIBUTES OF CHIPS COOKED BY PAN FRYING METHOD FROM MUSHROOM, HERBS AND SPICES

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ABSTRACT

Introduction: The intake of snacks such as potato chips is becoming popular among Malaysians. However, these snacks usually contain high calories but low in nutrients. The objective of this research was to develop acceptable and healthy chips made of rice straw mushroom mixed with herbs and spices. **Methods:** The chips were prepared in six different formulations using a standard formula with addition of rice straw mushrooms and mixture of herbs and spices such as cinnamon, garlic, onion, ginger, holy basil, and turmeric. The chips were cooked using pan-frying method that used a thin layer of oil and subsequently underwent sensory evaluation by 35 untrained panelists that consist of university students from International Islamic University, Kuantan. The sensory evaluation involved five parameters which were appearance, odor, taste, texture, and overall acceptance that based on the 9-point hedonic scales. Analysis of variance (ANOVA) and the Tukey post-hoc test were used to determine the significant mean difference in the sensory attributes among the formulations at a 95% confidence interval ($p < 0.05$). **Results:** Of six different formulations, there were no significant differences found ($p > 0.05$) in terms of appearance and odor. However, the texture, taste, and overall acceptance attributes were significantly different ($p < 0.05$). **Conclusions:** The result of the study showed that formulation 6 without the presence of turmeric is the most acceptable chips due to its odor, taste, texture, and overall acceptance modalities.

KEYWORDS: Snack, Chips, Rice Straw Mushroom, Herbs and Spices, Pan-Frying

INTRODUCTION

Junk food is a termed specifically used for foods that are high in energy but lack of nutritional values such as protein, fiber, vitamins, and minerals (Das, 2016). These foods include fast food which being unhealthy with unhealthy snack (Mage, 2007). Sallis, Owen, and Fisher (2008) mentioned that frequent intakes of snack such as potato chips are practically common

AN ASSESSMENT OF ACCEPTABILITY OF SENSORY ATTRIBUTES OF CHIPS.....

among young adults such as university students because of good taste, cheaper, and easily accessible. The intake of junk food could be associated with obesity, high blood pressure and elevated triglyceride (Datar and Nicosia 2012). There a number of strategies developed to prevent obesity and associated diseases, and these can include by providing healthier foods for snacking. According to Boa et al. (2013), the production rice straw mushrooms is increasing due to its nutritious and health benefits such as anti-cancer, anti-inflammatory, antioxidant, and anti-hypertensive. Its delightful flavor and aroma make it more preferable. Besides, it is also low in calories, fat, sodium, and cholesterol make it suitable to make alternative healthy snack. Spices and herbs are commonly being used by older people in culinary for health benefits as it is well known for its higher levels of antioxidant concentration which are usefully in inhibiting the oxidation of LDL. In this study, we developed chips made of rice straw mushroom mixed with herbs and spices cooked using pan frying method. The chips were prepared in six different formulations and subjected to sensory evaluation to determine which formulations offer the best in term of appearance, aroma, taste, texture and overall acceptance. Pan frying method was chosen because it has higher nutrition quality compared to other frying methods which involved a thin layer of oil in the process of cooking.

METHODS

This research was conducted in the food preparation laboratory and sensory evaluation laboratory of the Department of Nutrition Sciences, Kulliyah of Allied Health Sciences, International Islamic University Malaysia, Kuantan. There was no previous study performed on this research project. Thus, the sample size should be at least 30 students as described by Stone and Sidel (2004). In this study, a total of 35 university students aged between 19-25 years old were required for the sensory evaluation based on few inclusion and exclusion criteria: The subjects were recruited from International Islamic University Malaysia, Kuantan with varied BMI. The subjects were healthy and free from any impairment that can affect their taste. This study was an experimental study where it included a preparation of different formulations of rice straw mushroom mixed with herbs and spices chips, and followed by a sensory evaluation to determine the best formulations. Before the real production took place, several pilot studies were performed in order to obtain the correct method and recipe. The best recipe was selected from all the changes and used for the development of six different formulations chips labeled as F1, F2, F3, F4, F5, and F6. Each formulation varied in terms of the type of herbs and spices used as stated in Table 1.

AN ASSESSMENT OF ACCEPTTIBILTLY OF SENSORY ATTRIBUTES OF CHIPS.....

Table 1 Spices and herbs used in chips preparation.

F 1	F2	F3	F4	F5	F6
Cinnamon	Cinnamon	Cinnamon	Cinnamon	Cinnamon	Cinnamon
Garlic	-	Garlic	Garlic	Garlic	Garlic
Onion	Onion	-	Onion	Onion	Onion
Ginger	Ginger	Ginger	-	Ginger	Ginger
Holy Basil	Holy Basil	Holy Basil	Holy Basil	-	Holy Basil
Turmeric	Turmeric	Turmeric	Turmeric	Turmeric	-

Grounded cinnamon, garlic, onion, ginger, turmeric, paprika, and holy basil were purchased from the super-market while the rice straw mushrooms were provided by a mushroom farm owner who collaborated in this project. The rice straw mushrooms were cleaned to eliminate any contaminants. Next, the mushroom was cut into smaller pieces and dried in the oven at 180°C for 10 minutes. The dried mushroom was weighed to 120g mixed with 100g of chickpea flour, 60ml of water, and 5g of each spices and herbs according to the formula in the food processor. Five grams of salt and paprika was/were added into the mixture to enhance flavor and was mixed thoroughly to become dough. A small amount of flour was added into the dough continuously until it achieved the correct consistency. The dough was compressed into thinnest using the kitchen roller and cut into square shape chips. The square shaped chips were cooked in the pan using small amount of palm oil over a medium heat. The chips were cooked in one layer and turned after 2 minutes until they became golden brown on both side. Next, the fried chips were removed from the oil and placed it on the kitchen towel to remove the excess oil. Lastly, the chips were let cooled and inserted into the plastic zip-lock for sensory evaluation. Each of the zip-lock was labeled with F1, F2, F3, F4, F5, and F6 according to the formulation.



Figure 1. The end-product of rice straw mushroom chip mixed with herbs and spices.

AN ASSESSMENT OF ACCEPTTIBILTLY OF SENSORY ATTRIBUTES OF CHIPS.....

The sensory evaluation was conducted in the International Islamic University Malaysia, Kuantan. All panelists were given informed consent before participating in this study. Each of the panelists was given six chips from different formulations to evaluate. To avoid mixing of flavor, plain water was given to rinse the mouth after each chip was consumed. The evaluation performed namely appearance, odor, taste, texture, and overall acceptance using the 9-point hedonic scale. The scale of values ranged from 'Like extremely' to 'Dislike extremely'. All the data of the sensory evaluation were analyzed using statistical package for social sciences, SPSS software (version 21.0). Descriptive statistics such mean and standard deviations were calculated. Analysis of variance (ANOVA) and Tukey post-hoc test was used to determine the significance of differences in the means of the formulations at 95% confidence interval ($p < 0.05$).

RESULTS

Sensory Evaluation

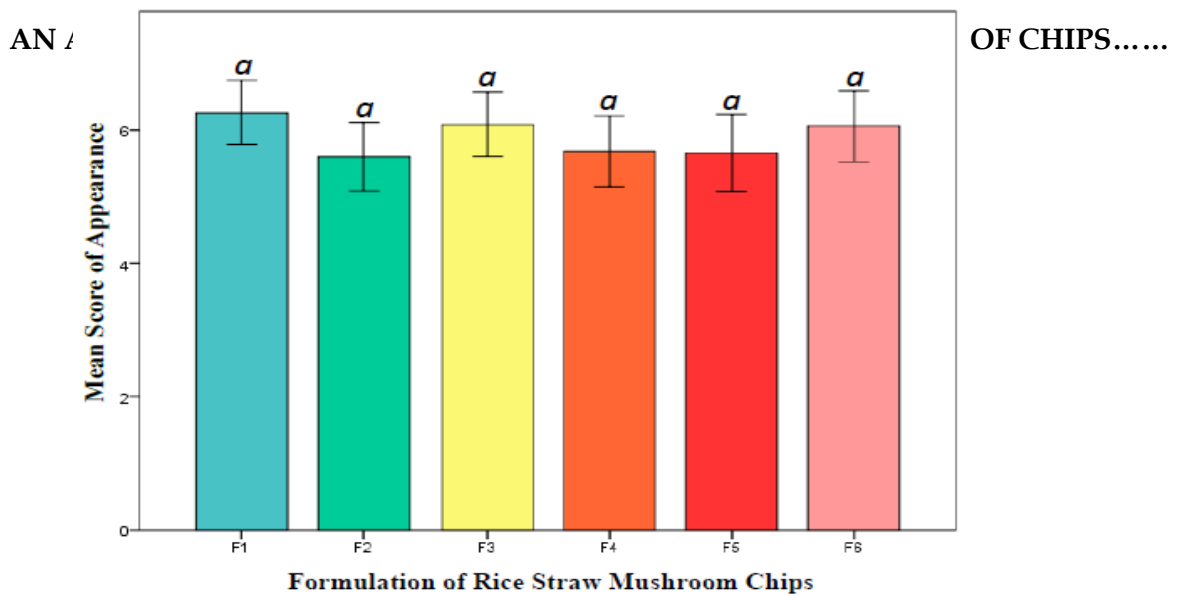
From the Table 2, it is evident that there were significant ($p < 0.05$) differences in the texture, taste, and overall acceptance level between formulations. However, the appearance and odor attributes were not significantly different. From the overall acceptance mean score, it shows that F6 scored the highest mean value with 5.86 followed by F3 (5.17), F4 (5.11), F1 (5.09), F2 (5.03), and F5 (4.54). This indicates that the students prefer formulation 6 compared to other formulations. Besides, F6 has scored the highest mean for all sensory criteria except for the appearance parameters.

Table 2 Comparison of the mean values of all sensory criteria of 6 formulations.

	Mean Value \pm SD						<i>p</i> -Value
	F1	F2	F3	F4	F5	F6	
Appearance	6.26 \pm 1.400	5.60 \pm 1.499	6.09 \pm 1.401	5.69 \pm 1.549	5.66 \pm 1.697	6.06 \pm 1.519	0.330
Odor	6.03 \pm 1.855	6.11 \pm 1.641	5.91 \pm 1.721	6.06 \pm 1.626	5.97 \pm 1.886	6.23 \pm 1.699	0.982
Texture	4.46 \pm 1.704	5.14 \pm 1.630	5.26 \pm 1.945	4.40 \pm 1.805	4.34 \pm 1.697	6.46 \pm 1.788	0.000
Taste	4.91 \pm 1.755	4.69 \pm 1.659	4.89 \pm 1.967	5.34 \pm 1.679	4.60 \pm 1.576	5.86 \pm 1.785	0.027
Overall Acceptance	5.09 \pm 1.669	5.03 \pm 1.654	5.17 \pm 1.807	5.11 \pm 1.623	4.54 \pm 1.400	5.86 \pm 1.768	0.050

Appearance

The Figure 2 shows that there was no significant difference ($p > 0.05$) in the mean score for appearance attribute among the 6 formulations. Hence, the appearance of the rice straw mushroom chips in all formulations is equally acceptable as all formulations scores was in the category of "slightly like".

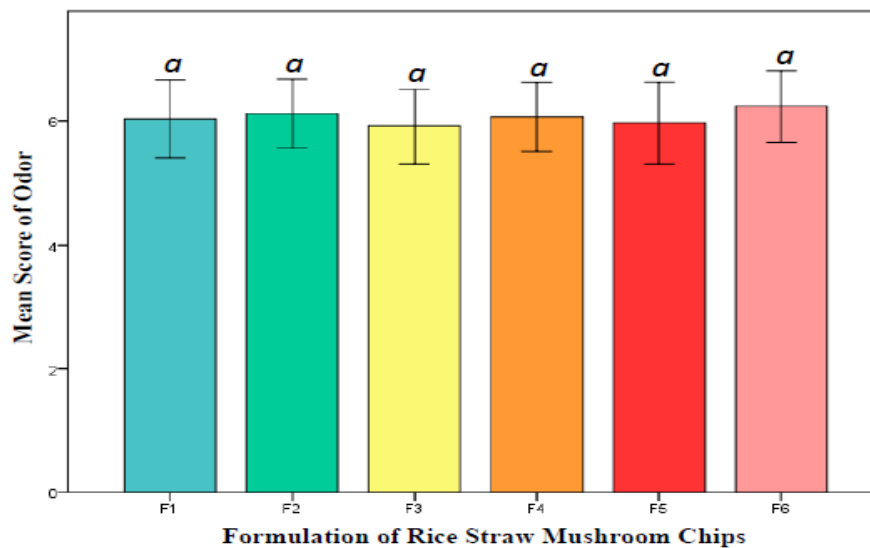


**Note: Similar superscripts denote no statistical different between formulations.*

Figure 2. The mean values for appearance criteria according to six different formulations.

Odor

The Figure 3 demonstrates that there was no significant difference ($p > 0.05$) between the formulations in the mean score of odor acceptance. Hence, it can be concluded that students equally accepted the odor of the rice straw mushroom chip as all formulations fall in the positive categories which is “slightly like”.

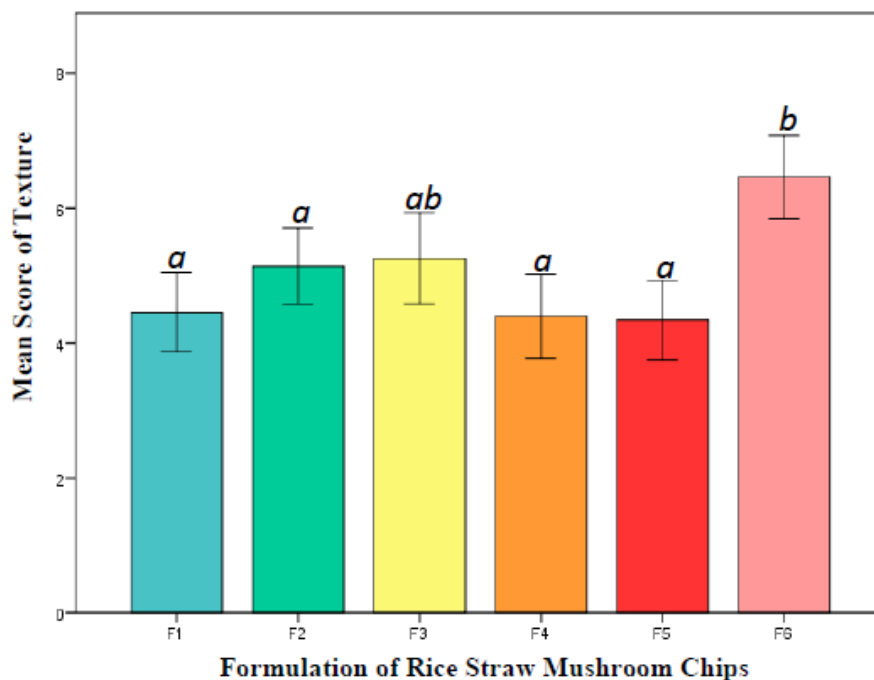


**Note: Similar superscripts denote no statistical different between formulations.*

Figure 3. The mean values for odor criteria according to six different formulations.

Texture

The Figure 4 illustrates that F1, F2, F4, and F5 differed significantly ($p < 0.05$) with F6. The mean texture score of formulation 6 was the highest (6.64) among all the formulations. Hence, formulation 6 is considered highly acceptable rice straw mushroom chip in terms of a texture parameter.

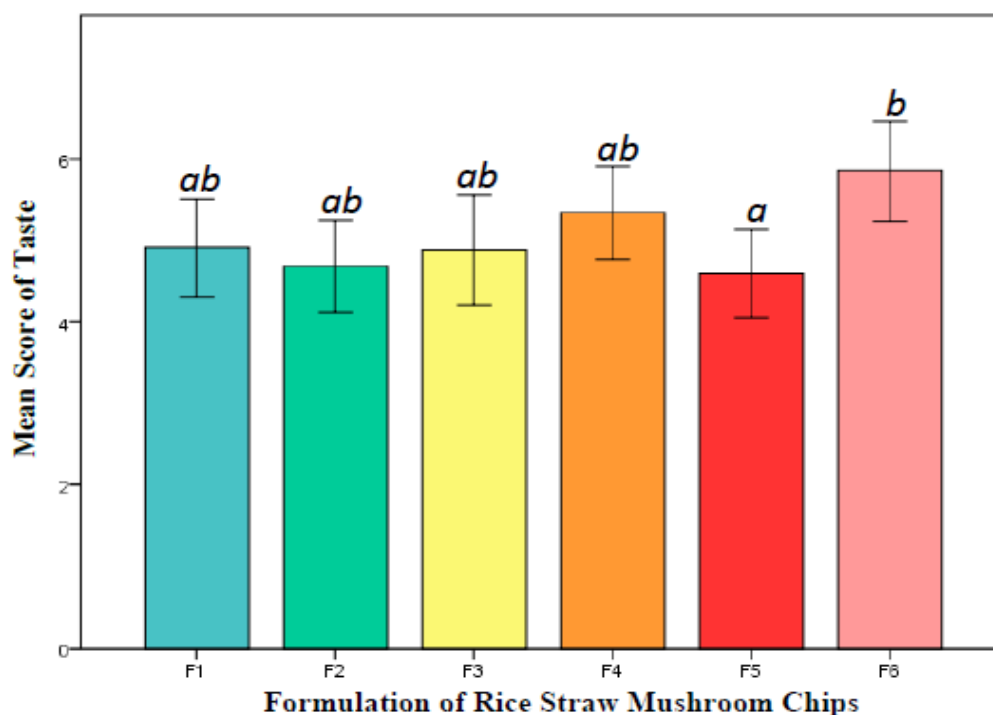


**Note: Different superscripts denote statistical different between formulations.*

Figure 4. The mean values for texture criteria according to six different formulations.

Taste

The Figure 5 shows that F5 and F6 were differed significantly ($p < 0.05$) in the taste score. F6 scored the highest mean score of taste (5.86) indicating that it was the most preferred formulation.

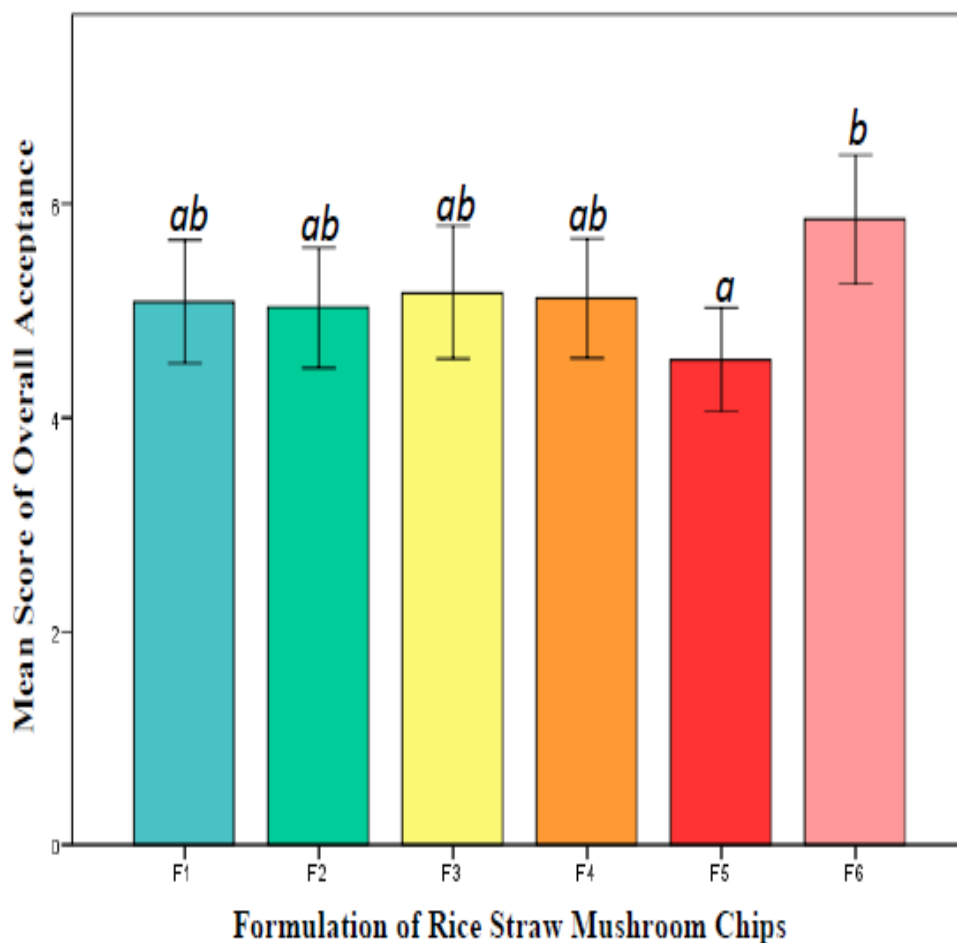


**Note: Different superscripts denote statistical different between formulations.*

Figure 5. The mean values for taste according to six different formulations.

Overall Acceptance

The Figure 6 shows that F5 and F6 were significantly different ($p < 0.05$) in terms of overall acceptance. However, F5 and F6 did not differ significantly compared to F1, F2, F3, and F4. F6 scored the highest mean score of overall acceptance indicating that it was the most acceptable formula. In contrast, formulation 5 score the lowest suggesting that it was the least acceptable formulation by the panelists.



**Note: Different superscripts denote statistical different between formulations.*

Figure 6. The mean values for overall acceptance criteria according to six different formulations.

DISCUSSION

In this study, six formulations of chips were freshly prepared using different amount of rice straw mushroom mixed with herbs and spices. Subsequently, the chips underwent a sensory evaluation to evaluate the acceptability between formulations in term of food attributes such as appearance, odor, texture, taste, and overall acceptance. The sensory evaluation usually involves five senses which are sight, smell, touch, taste, and hearing. Input that process by the sensory organs will be transmitted to various locations in the brain and the responses are formulated (Miller, 2017). Since senses cannot be substituted with any food analysis apparatus, a panel of 35 untrained judges were selected from students of the IIUM, Kuantan Campus. Appearance was the first sensory criteria that were evaluated by our panelists. The appearance of food products plays a significant function as it is the first attribute that perceived by human senses. Sharif et al. (2017) mentioned that the appearance includes different visual perception such as color, size, and shape. Our analysis reveals that there was no significant difference in

the appearance mean score between the formulations. It can be concluded that the appearance of the rice straw mushroom chip was equally acceptable to the panelists as all formulations reach the positive categories. The result may have been influenced by the color, size, and shape of the chips as they were relatively similar between formulations. All formulation chips appeared to be golden brown, square in shape, and same size. Furst et al. (1996) mentioned that the browning effect of the chip is due to the Maillard reaction which depends on the amount of reducing sugars and amino acids at the surface of the chips. Besides, the temperature and the time of frying also contribute to the appearance of the chip where low temperature produces slightly brown color and high temperature cause darker brown color chips. Moreover, Mohammed et al. (2012) stated that chickpea causes an increase in the Maillard reaction as it contains higher lysine compared to wheat flour. The aroma is a volatile compound that is detected via odor receptors of olfactory tissues located in the nasal cavity. According to Mottram and Elmore (2003), a human is able to detect a significant number of odorants that affect the recognition and flavor of a particular food where Sharif et al. (2017) mentioned that pleasant odor improves the taste of a product. During the mastication process, the combination of aromatic compounds and mouth feel triggered the sensation of taste in food. Besides, the condition of food such as the freshness and the rancidity of food can be determined by the aroma (Sharif et al., 2017). Our study showed that the panelist equally accepts the odor of the rice straw mushroom chips as there was no significant difference in the mean values between the formulations. Herbs and spices are well known to provide multi-sense pleasure and offer good odor especially in cooking thus helps to increase the acceptability of the food (Tapsell et al., 2016). Sharif et al. (2017) stated that texture is a combination of multiple senses including touch, mouth-feel, sight, and hearing. The texture attribute of food can be detected through the sound created during consumption where sound that produces during biting chips indicated the crispiness of the food. The result of our analysis reveals that there were significant differences in the mean score of texture criteria where formulation 6 score the highest compared to other formulations with the exception of formulation 3. It can be suggested that formulation 6 was the most acceptable rice straw mushroom chip in terms of texture parameters. Salvador et al. (2009) mentioned that crispness, hardness, and crunchiness are the common texture feature of a chip. Chip is considered stale and inedible once it has lost its crunchiness. Hence, the crispy texture is important in developing a chip as it associated with the freshness of the food where an unappetizing texture may cause the rejection of the chips. Besides, factors such as temperature of the oil, frying time, batches in frying, and food surface area affect the desirable mouthfeel where it influences the amount of oil absorbed (Choe and Min, 2007). Low temperatures of oil increase the amount of oil absorbed in food as the crushed form slower while high temperatures cause the food to be burnt faster. Next, it is recommended to shape the food at the same size to ensure the mushroom chips fry at the same time. In this study, the mushroom chips were fried in large batches at the same time due to limited time that causes by the COVID-19 spread. This might influence the result as frying in large batches at one time can cause the oil temperature to quickly drop which leads to excessive oil absorption. Moreover, the texture of chips correlated with the fat content and the composition of the frying medium where

higher frying temperatures decrease the hardness of the chip that leads to a crispy texture (O Mirzaei, 2015). The fourth sense that was evaluated in this study is the taste. In general, there are four basic tastes that perceived by humans which are sweet, sour, salty, and bitter. A sense of taste is a chemical sense that identifies along with the tongue through the taste receptor called taste bud. When there is interaction with a water-soluble compound it stimulates the tongue receptor and a flavor is perceived (Miller, 2017). Sharif et al. (2017) mentioned that a combination of taste and odor influences the flavor of food. Based on our result, formulation 6 had the highest score taste, however it was only significantly differed with formulation 5. The difference between formulation 6 and the other formulations is that formulation 6 did not contain turmeric indicating that different types of herbs and spices possess a different flavor. Turmeric is a type of herbs derived from the ginger family and does not have a desirable flavor where it has a pungent, earthy, and bitter flavor (Prucksunand et al., 2001). Besides, chickpea flour also influences a bitter taste toward the chips as mentioned by Mohammed et al. (2012) enhancing the level of chickpea flour in crackers caused the higher intensity of leguminous taste and caused a slightly bitter taste. According to Breslin (2013), bitter taste in food lower the acceptance of food. Besides, the result might be influenced by the texture and smell of food as both factors contribute to taste preferences (Jaren et al., 2016). The final sensory attribute evaluated was the overall acceptance. This parameter is critical in the product development stage as it helps in deciding the general perception of all other sensory attributes. Our result showed that there was a significant difference in mean value between formulations in terms of overall acceptance. The acceptance is reflected by the perception in appearance, aroma, texture, and taste criteria where formulation 6 had the highest mean score for all sensory parameters except for appearance while formulation 5 had the lowest mean value for all sensory criteria except for odor. Overall, it can suggested that formulation 6 was the most acceptable and formulation 5 was the least acceptable chips made of rice straw mushroom chips mixed with herbs and spices.

CONCLUSIONS

In conclusion, this study showed that our chips were comparable in term of appearance and odor between all six formulations. Interestingly, formulation 6 was the most preferred chips as it had the highest score in the texture, taste, and overall acceptance level

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AN ASSESSMENT OF ACCEPTABILITY OF SENSORY ATTRIBUTES OF CHIPS.....

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