ASSESSMENT OF SENSORY ATTRIBUTES OF MUSHROOM CHIPS, MIXED HERBS AND SPICES USING AIR FRYING METHOD

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ABSTRACT

Introduction: Snacks are well-known among consumers and come in a variety form. The availability of snacks in the market is high in calories, sugar, salt as preservatives but low in nutrient content. Current food system that is not focusing on the development of healthy snacks and abundance of unhealthy food choices contributed to the lack of exposure among consumers to healthier food choices. 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 were known to produce better nutritional quality of chips. **Methods:** The mushroom chips were developed, and the sensory evaluation result was analysed in terms of sensory attributes and overall acceptability. Six different formulations of mushroom chips mainly formulated from a mixture of herbs and spices such as cinnamon, ginger, onion, garlic, turmeric and holy basil. A total of 35 panellists were randomly selected as volunteers to evaluate the acceptability of sensory attributes of the experimental six different formulations of mushroom chips. **Results:** There is no significant difference in sensory attributes such as appearance, aroma, taste, texture and overall acceptance of all six formulations observed, which made it equally acceptable to panellists. **Conclusions:** F3 has found to be the most preferred mushroom chips formulations in terms of sensory attributes. The outcome of this study can be made as valuable information in producing a healthy snack as an alternative.

KEYWORDS: Rice Straw, Mushroom, Herbs, Spices, Sensory Evaluation, Chips, Air frying

INTRODUCTION

Snacks is a pejorative term for readily available, inexpensive food and usually containing elevated levels of calories from sugar or fat with low nutrients such as fibre, protein, vitamins or minerals. The availability of snacks in the market are high in calories, sugar and salt as preservatives but low in nutrients. Around the world, the trend towards consumption of junk food is increasing (Shukri and Mohd Noor, 2017). However, the availability of healthy snacks in the market is limited. The availability of snacks in Malaysia mainly contained higher number of calories, fat, sugar but with a very low number of vitamins, minerals and fibre content. Increased intake of unhealthy foods is being compounded by the rise in unhealthy food output and its consumer demand. All throughout the past, mushrooms have been eaten as a delicacy because they have a particularly desired flavour and aroma (Kalac, 2012). In relation to many potential positive impacts to human health and flavors, edible mushrooms are appeared to be a valuable source of nutrients and bioactive compound (Valverde, Hernández-Pérez and ParedesLópez, 2015). The nutritional content of straw mushroom is influenced by the crop raising cultivation procedure and the maturation process. Straw mushrooms contain about 90% water, 30-43% crude protein, 1-6% fat, 12-48% carbohydrates, 4-10% crude fibre and 5.13% ash content (Ahlawat and Tewari, 2007). The mushroom is high in protein, potassium and phosphorus content (Ahlawat and Tewari, 2007) but low in alkalinity, fat, cholesterol content and salt-free (Gummert, Hung, Chivenge and Douthwaite, 2020). In many centuries' years ago, spices and herbs have been used widely (Vasanthi and Parameswari, 2010; Oparah and Chohan, 2014; Yashin et al., 2017). Spices and herbs are reputable antioxidant sources and other potential bioactive dietary compounds that are extremely low in calories and relatively inexpensive (Vasanthi and Parameswari, 2010). According to the literature available, there are several benefits suggested for the physical wellbeing of humans. According to Oparah and Chohan (2014), research has been increased into the role of spices and herbs contributing to dietary polyphenols which has a variety of features that minimize the risk of chronic non-communicable diseases (NCDs) over the last decades. The review also connoted solid evidence that intake of spices and herbs is necessary and appropriate to minimize or even eradicate harmful effects on human status health when incorporated regularly in daily meal consumption. Therefore, spices and herbs should undoubtedly be included as part of a healthy, nutritious food and a functional ingredient in food (Yashin, et al., 2017). Higher unhealthy food intake in the general population of Malaysia is possibly attributable to the limited supply of nutritious food on the market (Damari, Riazi-Isfahani, Hajian and Rezazadeh, 2017). The unavailability of nutritious foods was one of the obstacles to good eating practices in Malaysia (Sharkawi, Mohamed and Rezai, 2014). In a nutshell, this project which aims in develop preparation and acceptance of Rice

Straw Mushroom (*Volvariella Volvacea*) chips marinated with combination of spices and herbs by using air frying method from sensory evaluation will benefit the individual in the population.

MATERIALS AND METHODS

Panelists

In total, 35 panelists includes male and female undergraduate students from the International Islamic University Malaysia (IIUM) Kuantan campus were recruited for the sensory evaluation. Informed consent was obtained from the panelists. The respondents were selected purposively for this study, considering their inclusion and exclusion criteria and availability. Male and female panelists free from any health conditions on the day of sensory testing were purposely selected to perform the sensory evaluation session.

Development of Mushroom Chips

The composition of the chips is presented in the Table 1. Fresh Rice Straw Mushroom (*Volvariella Volvacea*) obtained from farm was cleaned, sliced while all of the spices and herbs involved were obtained from the supermarket nearby. Cleaned, sliced mushroom was pre-dried in the oven by oven drying method at 180°C for 10 minutes. Dried mushroom was then grounded into powder by using food processor. A total 120g of dried grounded mushroom were mixed with 5g of each spices and herbs together with 100g of chickpea flour and 60ml of water. 5g of paprika powder and 5g of salt were applied for each formulation in order to improve mushroom chips flavour. Mushroom mixture was rolled into thin layer and shaped into desirable chips shape. Each formulation was cooked with an air-frying method. Mushroom chips were placed in a tray bowl without being overlapped at a certain temperature which is 180°C for 5 minutes till cooked and packed into small plastics sized 6 x 8 cm. The mushroom chips were kept at room temperature for further sensory evaluation analysis session.

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-Hedonic scale was used by the respondents to evaluate the sensory criteria and 5 parameters were assessed which are appearance, aroma, taste, crispness and overall acceptance. All panellists were provided with six sample test chips according to six different formulations in the individual testing booths under white lighting. Sensory evaluation procedures were explained to the panellists before testing commenced. Panellists were asked to read through the instructions and the questions on the sensory form and the meaning of each attribute was explained to the panellists to

avoid misinterpretation. The panellists were given time to ask for clarification of the sensory evaluation procedure when uncertain or unclear about the process. Water at room temperature was provided to rinse the mouth in between the sensory evaluations before tasting of each mushroom chips samples.

Table 1. The composition of mushroom chips of six formulations.

	Formulation					
Mushroom (g)	120	120	120	120	120	120
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
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
Chickpea flour (g)	100	100	100	100	100	100
Water (g)	60	60	60	60	60	60

Statistical Analysis

The statistical analysis of results included simple one-way analysis of variance (ANOVA) using Statistical Package for Social Sciences, SPSS Statistical Software (Version 21.0) (SPSS Inc., Chicago, USA) to calculate means ± SD of values measured for each sample. The analysis was carried out by using one-way analysis of variance (ANOVA) and significance of the difference was certain at 95% confidence interval ($p<0.005$). Further the difference in mean was determined by Tukey Post Hoc (also called Tukey_s Honest Significant Difference test) were used to determine significant difference in the various formulations.

RESULTS

Sensory Evaluation

The overall results of this study are shown below in the Table II. The collected data was statistically analysed using one-way analysis of variance which showed that sensory attributes in terms of appearance, aroma, taste, texture and overall acceptability among the samples of formulations were not different as shown in

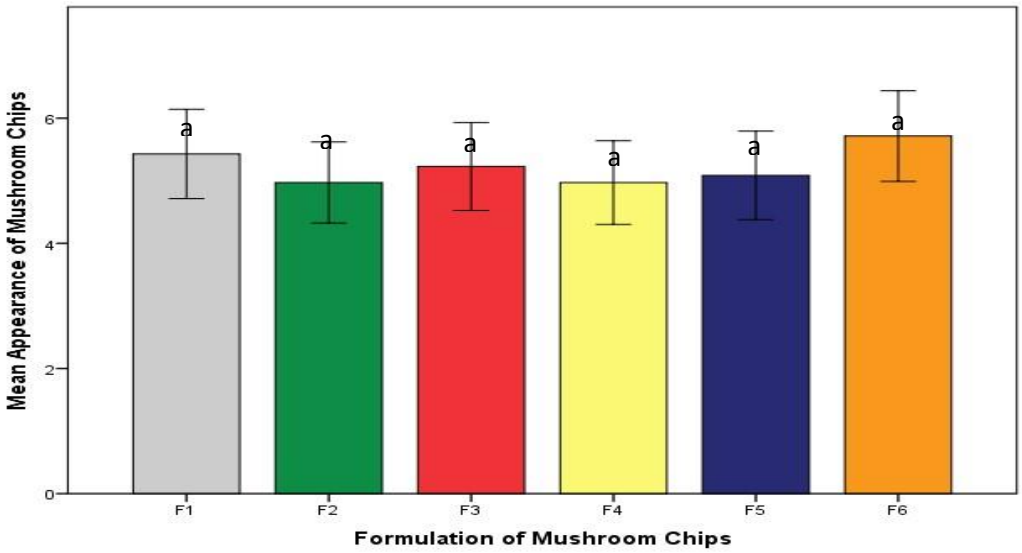
Table 2. However, the results for all sensory attributes were not significantly difference, thus the acceptability of all the sample formulations were similarly accepted.

Table 2 The mean score of the Sensory Attributes between Formulations.

		Sensory Attributes				
	N	Appearance	Aroma	Taste	Texture	Overall Acceptance
F1	35	5.43 ± 2.08	5.66 ± 2.27	4.40 ± 2.06	4.46 ±2.53	4.60 ± 2.10
F2	35	4.97 ± 1.89	5.74 ± 2.02	4.80 ± 2.06	4.83 ±2.35	4.89 ± 1.80
F3	35	5.23 ± 2.05	5.14 ± 2.13	4.51 ± 1.95	5.00 ±2.24	4.91 ± 2.01
F4	35	4.97 ± 1.95	5.43 ± 2.09	4.40 ± 2.37	4.66 ±2.63	4.71 ± 2.42
F5	35	5.09 ± 2.06	4.94 ± 2.18	4.46 ± 2.10	4.63 ±2.55	4.60 ± 2.10
F6	35	5.71 ± 2.02	5.37 ± 2.13	4.54 ± 2.09	5.17±1.99	4.86 ± 2.09

Appearance

The sensory attribute of appearance, a parameter in the acceptability and the acceptance score is presented in the Figure 1. The statistical analysis showed that there was no significant difference between the six sample tests of formulations. This suggests that the appearance of the mushroom chips was not very much different between each other and were equally acceptable to the panellists.

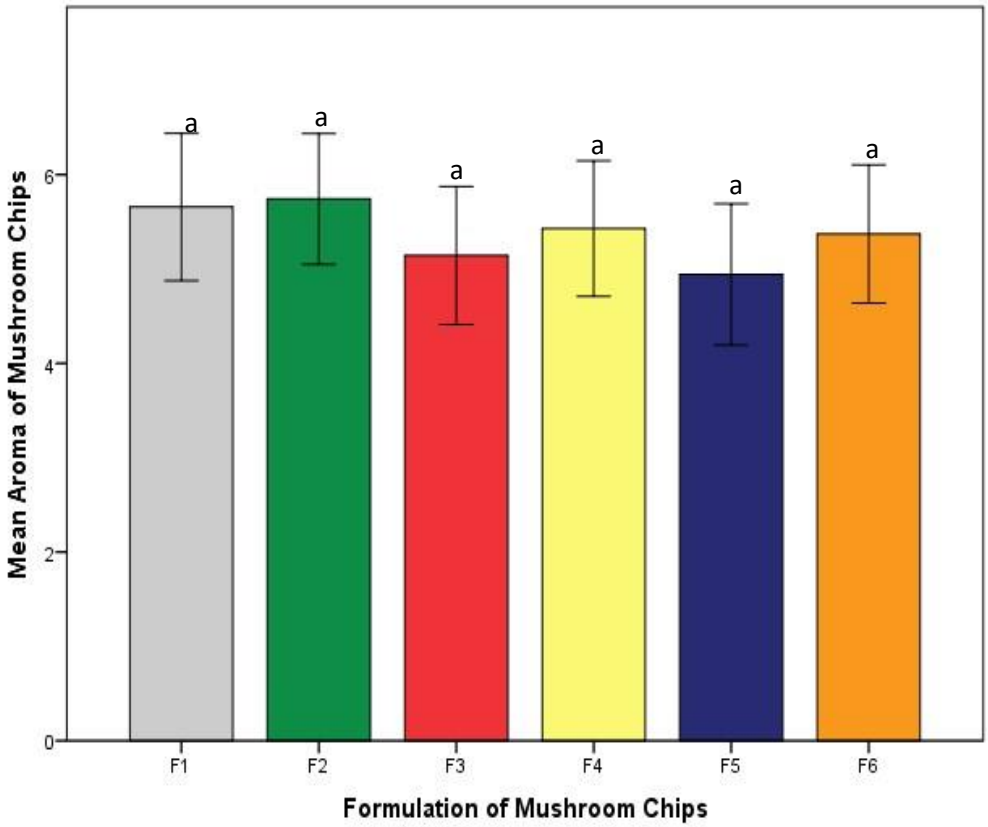


**Note: Similar in superscript indicates similar significant difference*

Figure 1. Graph of the mean score for appearance of mushroom chips according to six different formulations.

Aroma

The results obtained for the sensory attribute for aroma as the parameter for the acceptability on aroma mean score are presented in the Figure 2. The presented result confirmed that there was no statistical difference in the consumer acceptability based on sensory attribute for aroma of mushroom chips. The findings on aroma attribute at least hint that the aroma of the mushroom chips was equally accepted by the panellists.



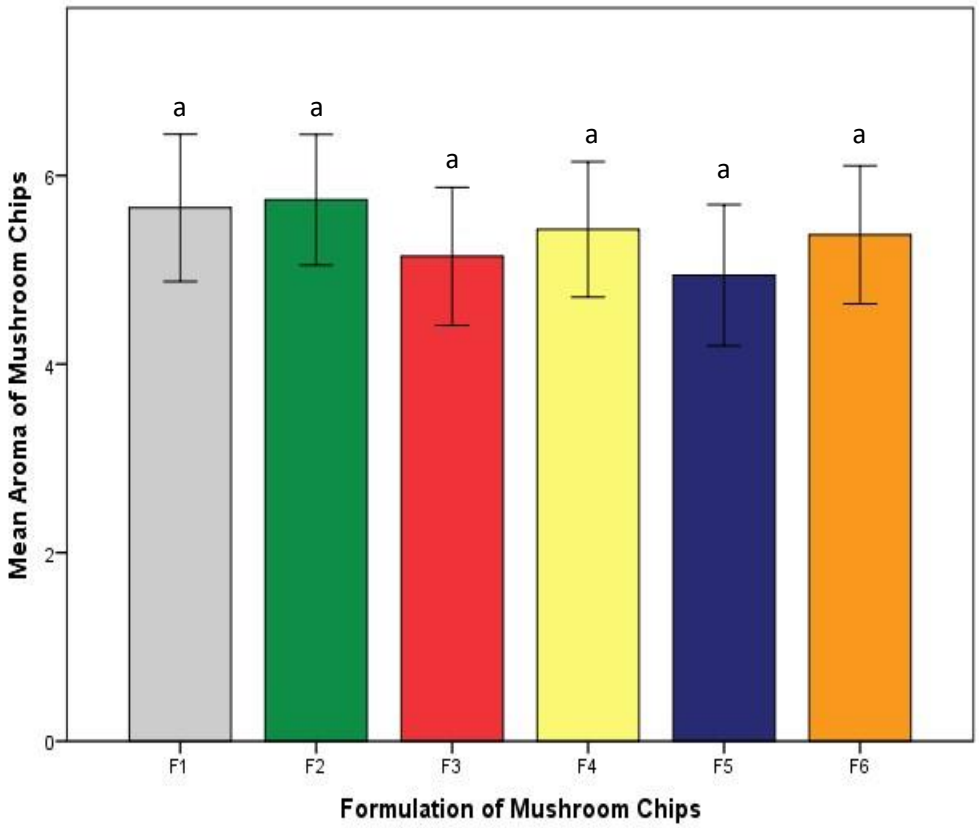
**Note: Similar in superscript indicates similar significant difference*

Figure 2. Graph of the mean score for aroma of mushroom chips according to six different formulations**.**

Taste

The mean score for the sensory attribute which is taste was also obtained in Figure 3 as part of the recognition of the mushroom chips as a sensory trait. Another

promising finding was the results showed that none of the mushroom chips acceptability was differ based on the sensory attribute for taste of the mushroom chips. The result now provides evidence that the formulation with different spices incorporated into the mushroom chips produced comparable taste.

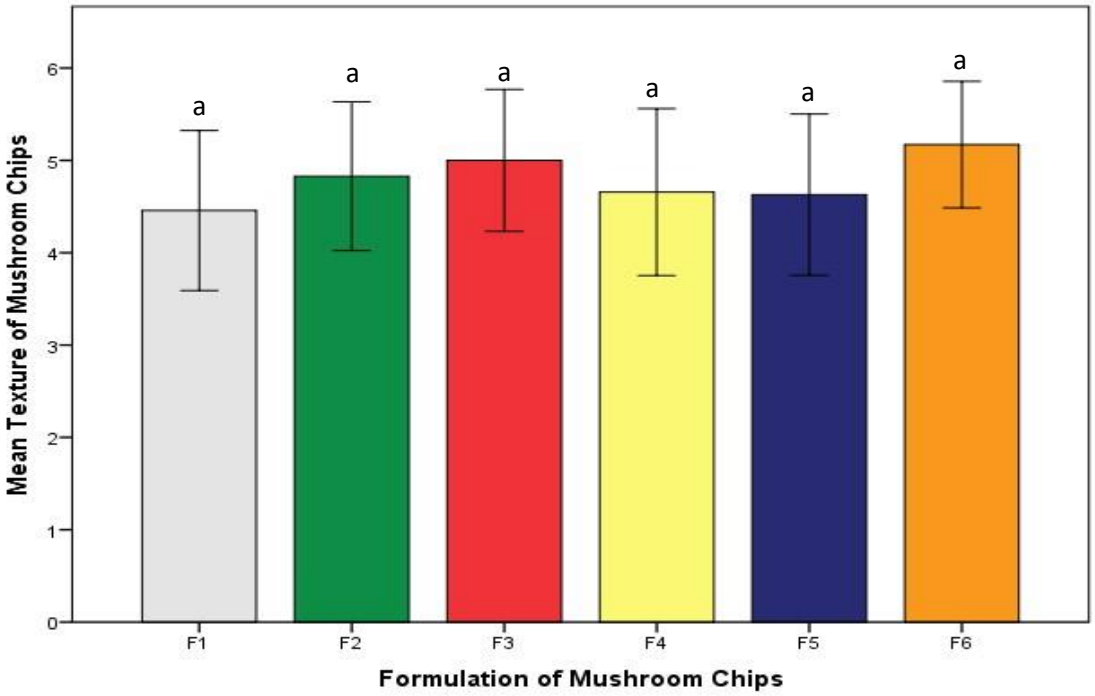


**Note: Similar in superscript indicates similar significant difference*

Figure 3. Graph of the mean score for taste of mushroom chips according to six different formulations**.**

Texture

The mean score for the texture attribute of mushroom chips is presented in the Figure 4. The mean score for texture attribute has no significant difference with the p-value ($p>0.005$) among all the six total sample test formulations. The results clearly demonstrated that the texture of the mushroom chips was equally acceptable for the panellists.

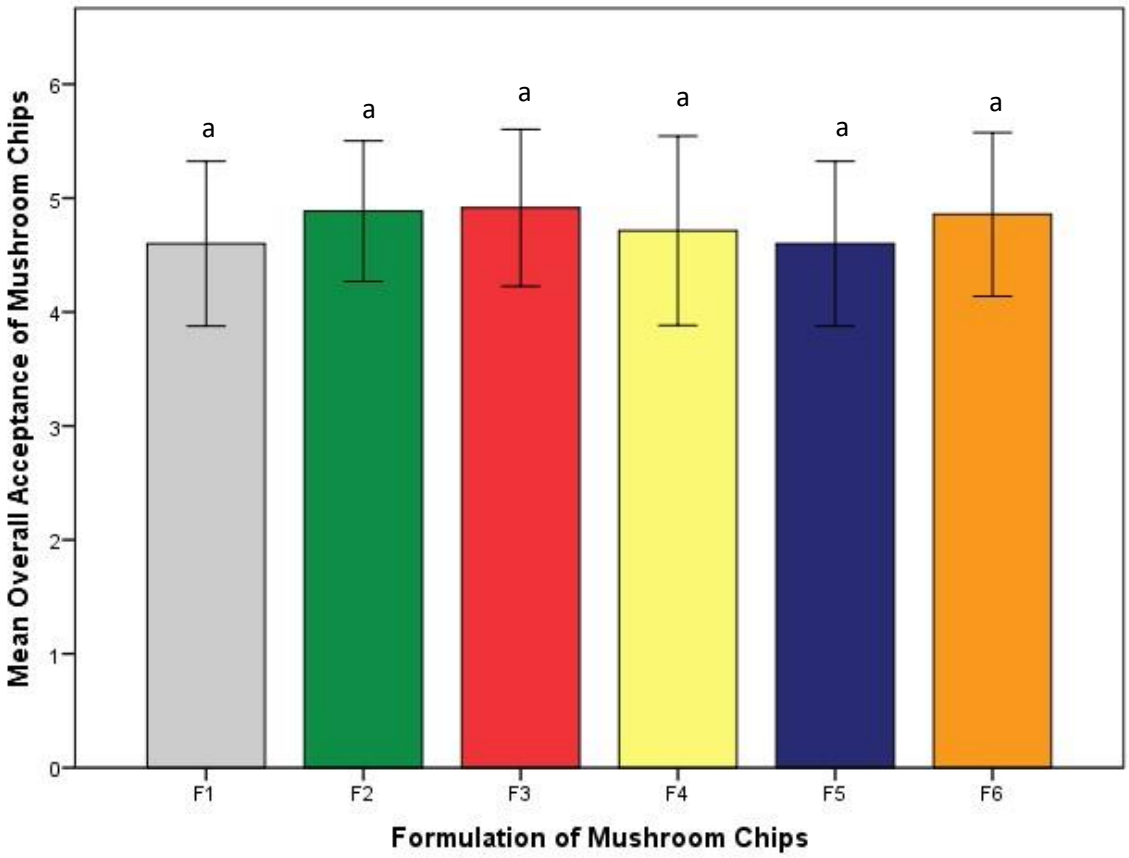


*Note: Similar in superscript indicates similar significant difference

Figure 4. Graph of the mean score for texture of mushroom chips according to six different formulations.

Overall Acceptance

Figure 5 shows an important finding in the understanding of the overall acceptance as the parameter in the acceptability and the acceptance of the mushroom chips. The result shown demonstrated that there was no statistical different in the acceptability based on overall acceptance of the mushroom chips. In another word, the overall acceptance of the mushroom chips was equally accepted by the panellists.



*Note: Similar in superscript indicates similar significant difference

Figure 5. Graph of the mean score for overall acceptance of mushroom chips according to all six different formulations.

DISCUSSION

Kilcast (1998) defined sensory evaluation as a quantitative study that collects numerical data in order to establish a legally defined link between product characteristics and perception of humans. The variables affecting food quality and choice preference used include the sensory criteria of appearance, aroma, color, texture and taste in this research. The sensory testing was not performed merely in the sensory evaluation laboratory room only throughout this study. The environmental factors were also uncontrolled because the sensory evaluation sessions were conducted in different locations. The sensory evaluation environment such as the lighting and ventilation, the level of noise and extraneous odors may adversely influence the result of this research (Kilcast, 1998). The experimental study of Rice Straw *(Volvariella Volvocae)* Mushroom chips mixed with spices and herbs shown that there were no significant differences in terms of sensory characteristics such as appearance, aroma, texture, taste and overall

acceptability. Colour of mushroom chips is one of the most important quality factors determining the consumer acceptability (Krokida and others, 2001). The color of the end-product mushroom chips were golden brownish in color. The frying temperature used and frying time also contributed to the color and browning effect of the mushroom chips which give the appearance of golden brownish, rectangular and same size of the mushroom chips. Color difference of food material fried in atmospheric pressure is reported to be lower than that in deep frying method due to the reduction of oil absorption (Shyu, Hau and Hwang, 2005). Thus, the result demonstrated that all formulations of the mushroom chips incorporated with mix spices and herbs were accepted in terms of appearance by the panelists.

Aroma is one of the critical aspects of mushroom chips quality which can determine acceptance or rejection of mushroom chips before it is tasted. Sharif et al. (2017) connoted that pleasant odor improves the taste of a product. Teruel et al. (2015) further showed in their study that larger variations in frying time and temperature used in air frying method resulted in significant changes in aroma produced of the food resulting in a pleasant aroma and taste of a particular food. The result of the experiment found a clear support that the aroma of the mushroom chips was accepted equally by panelists as there is no significant difference between the six formulations. The sample test for Formulation 2 scored the highest for taste which is 4.80. The results of this study found a clear support for the increase in acceptability of taste when garlic has been excluded out of the mushroom chips. Ahmad (1996) claimed that a powerful odor of the human breath comes up on consumption of garlic. Thus, this could be attributed to the high intense of the spice taste of garlic impacting a bitter taste in the sample. Generally, the panelists agreed that chips prepared from the cooking type of air fried mushroom varieties had acceptability of very good to good chips taste.

Texture is an essential aspect of mushroom chips that is related to the consumer's satisfaction. In chips, a very crispy texture is expected all the way through since crispiness is an indicator of fresh and high quality (Troncoso and Pedresch, 2007). A substantial improvement in sample crispness when using 180^{o}C was observed by high temperature in air frying temperature. However, that study revealed that crust hardness significantly decreases when frying was done at 195^{o}C (Ngobese, Workneh and Siwela, 2017). Teruel et al. (2015) further showed in their study that larger variations in frying time resulted in significant changes in crust hardness because the crust tends to thicken and become harder at high temperatures. The crispy crust feeling of mushroom chips is induced by many shifts, which arise mostly at the cell and sub-cell rates at the outermost layers of the substance when it reaches 100°C by temperature when using air frying method. Frying for proper time could create a golden color, crispy texture and pleasant fried

flavor, but some studies showed that excessive frying time makes fried samples rigid, over-browned and higher oil absorption, which was speculated to be due to the different crust structure and porosity caused by longer frying time (van Koerten, Schutyser, Somsen and Boom, 2015; Ziaiifar, Achir, Courtois, Trezzani, and Trystram, 2008). In short, the acceptability in terms of the crunchiness texture of the mushroom chips for all formulations was accepted due to the cooking time and cooking temperature was kept constant throughout this study.

One of the most important quality parameters of mushroom chips end-products strictly related to consumers' perception is the overall acceptance. This parameter is important in the product development stage as it helps in deciding the general perception of all the sensory attributes. Mushroom chips in Formulation 3 (F3) were the most preferred chips among all the other formulations in all sensory parameter. The sample test for Formulation 3 had the highest score for overall acceptance with the score of 4.91 which represented ―neither liked nor disliked‖ category. The result has proven that the incorporation of onion into the mushroom chips formulation can decrease the acceptability of consumers. This is due to the pungency taste, which is a bitter, harsh or rough characteristic felt during ingestion of onion. Thus, it can be concluded that exclusion of onion from the mushroom chips increase the acceptability of overall acceptance for the mushroom chips.

CONCLUSION

This study aimed to propose a new functional food product and increase healthy choices on the-go snacks in the market in order to meet consumers demand towards easily consumable foods that suit their busy lifestyles. This research revealed that the sensory attributes such as appearance, aroma, taste, texture and overall acceptance of the mushroom chips between the six formulations were equally accepted by the panellists. The present results that the overall acceptance of mushroom chips confirmed that this product can be considered as accepted by panellists. Thus, the outcome of this study can be made as valuable information in producing a healthy snack as an alternative.

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