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A study on reducing fat content of fried banana chips using a sweet pre-treatment technique

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Abstract

Knowledge and concerns of the bad health implications of high fat intake in consumers has resulted in a rising demand for low-fat foods. Consequently, the use of sweet pre-treatment as alternative food source is gaining attention among producers and consumers. The study of reducing oil uptake of fried banana chips using sweet pre-treatment was done. In the preparation of fried banana chips, the sliced banana was blanched at 80°C. Then, the sliced banana was dipped in the treatment for 4 g, 8 g and 12 g of sugar solution. Next, the sliced banana was deep fried at temperature 180°C for 5 minutes. The result showed increased in percentage of moisture reduction (86.65 %, 86.99%, 88.37% and 90.51%) for control and other three fried banana chips as the concentration of sugar used for treatment was increased. For fat content, it showed a decreased in percentage (0.66%, 0.63%, 0.62% and 0.54%) as the sugar concentration used for the treatment was increased. Sugar treatment does not affect the colour of fried banana chips as p-value for lightness (L^*) is 0.426 and the p-value for yellowness (b^*) is 0.468. This showed that the null hypothesis was accepted and there was no significant difference in lightness and yellowness of all four fried banana chips. Finally, sensory evaluation showed that there was a significant difference in crispiness, colour, sweetness, oiliness and overall acceptance between all four fried banana chips. As the conclusion, sweet pre-treatment gives positive effect on reducing fat content in fried banana chips and can be used as one of the alternative method in producing banana chips with lower amount of fat.

Introduction

Banana is one of the important tropical fruits in Malaysia. It is a monocotyledon and belongs to the family Musaceae (Rowe, 1981). Most people consume it by raw, steamed or boiled. However, banana is easily ripe and it becomes a huge waste to the food industry. One of the method to process banana is to make banana chips. Banana chips are processed using deep-fried or dried slices of bananas. The chips can be covered with sugar or honey and have a sweet taste, or they can be fried in oil and spices and have a salty or spicy taste. Usually, the chips are produced from under ripe bananas, of which slices are deep-fried in palm oil or coconut oil, which are dry (like potato chips).If ripe bananas are used they come out oily. They are used for dessert, not for dry chips. Visual colour is the major quality criterion for determining the commercial quality with respect to consumers' preferences and cost of the chips (Abdullah, 2014). Packaging and storage condition are the most important quality control factors for chips preservation. Storage stability depends on packaging. Good packaging and storage condition extend the storage duration of chips.

Oil uptake during frying is also need to be considered during frying because the fat content of a product will also affect its flavour, odour and general organoleptic properties. The frying oil not only acts as heat transfer medium, because they are heated to high temperatures approximately 170-180°C, it will start to degrade through hydrolysis and oxidation of fatty acids. The breakdown products themselves give rise to flavour and can further react with carbohydrates, proteins and their decomposition products to produce taste traditionally associated with fried food. One of the alternative used to reduce fat content in chips is by doing a pre-treatment before frying. According to Mai Tran *et al.* (2007), pre-treatment technique will reduce the oil absorption by reduction of surface permeability. As a food product is fried, the internal cells become dehydrated and the evaporated water is partially replaced by the frying oil (Rosana *et al.*, 1997). Besides that, Saguy and Pinthus (1995)

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suggested that as the water is evaporated from the food product during frying, the rate of oil absorption increases due to a reduction in the pore internal pressure. The aim of the project was to determine the effect of using different concentration of sugar to the oil uptake of fried banana chips. Besides that, the moisture content of banana chips before and after frying, colour analysis and sensory evaluation were also being determined in order to study the effect of pre-treatment to the final fried banana chips.

Material and Methods

Preparation of fried banana chips

Firstly, the banana that has been sliced and blanched in hot water (80^{o}C) for 5 minutes. Next, the sliced banana was dipped into the sugar solution that has been added with 100 ml of distilled water. Sugar solutions with different concentration (4 g, 8 g and 12 g) were prepared. The sliced bananas were dipped in sugar solution at different concentration for 30 seconds. Then, the moisture content on the sliced banana was determined before and after frying. The sliced banana were deep fried pan using palm oil at the temperature 180^{o}C and fried for 5 minutes until the banana chips turn brown.

Determination of moisture content of raw and fried banana chips

Moisture was determined by using moisture analyzer, (Sartorious MA 35, Germany). All reading was done in triplicate and the mean for moisture content were presented in mean ± standard deviation value.

Determination of fat content in fried banana chips using Soxhlet extraction

The empty solvent beaker was weighed. Then, 2 g (0.01) pre dried sample were weighed and placed into a pre dried extraction thimble. NOTE: If the sample contains more than 10% , dry the sample to constant weight at 95-100°C under pressure for about 5 hour. Filter paper was put with sample into the thimble that covered with cotton wool. The thimbles were transferred in soxhlet extraction. 125 ml petroleum ether was added in the solvent beaker. SOP/OP/002-BUCHI-Soxhlet Extraction System were referred to start up the process. The unit completed after 2hours and 30 minutes. Oven was pre- heated at 100°C 10 minutes before unit complete. The solvent beaker were dried with extracted fat in an air oven at 100°C for 30 minutes, cooled in desiccator's and the weighed was determined. The result was recorded and presented in mean ± standard deviation value.

Determination of colour of banana chips using Chromameter

The banana chips were blended and 2 g of banana chips were measured. All reading were taken as L^*, a^*, b^* colour space values. Chroma C^* was calculated as $\sqrt{a^*2 + b^*2}$ and que was calculated from, the arc tangent of b^*/a^*. Calibration of the instrument was performed using a white ceramic tile (L^* = 98.06, a^* = -0.23 and b^* = 1.87) before measuring each new set of triplicate samples.

Sensory evaluation of banana chips

Sensory evaluation was conducted by sensory of 5 attributes which were colour, crispiness, sweetness, oiliness and overall acceptance by 50 untrained panelists. The hedonic test is most suitable method to determine the consumer acceptability towards the banana chips. Data from Hedonic test was then analyzed using ANOVA Single Factor to determine is there any significant difference between four banana chips in colour, crispiness, sweetness, oiliness and overall acceptance.

Results and Discussion

Moisture analysis

Food moisture analysis involves the whole coverage of the food items in the world because foods are comprising a considerable amount of water rather than other ingredients. Moisture content of the food material is important to consider the food is suitable before the consumption, because moisture content affects the physical, chemical aspects of food which relates with the freshness and stability for the storage of the food for a long period of time and the moisture content determine the actual quality of the food before consumption and to the subsequent processing in the food sector by the food producers. In this research, effect of dipping with different concentration of sugar to moisture content of banana chip was determined. From Figure 1, moisture content of banana chip was decreased as the concentration of sugar was increased. Moisture content in fried banana chips was affected by the sugar concentration. From Table 1, the highest moisture reduction was 12 g chips (90.51%) and the lowest moisture reduction was control chips (86.65%). Similar results were obtained by Mai Tran *et al.* (2007). The moisture content in sugar dipped potato chips decreased quickly than control samples. This might be due to osmotic dehydration. Osmotic dehydration is the process of water removal by immersion of water-containing cellular solid in a concentrated aqueous solution. In this research,

Table 1. Percentage of moisture loss in fried banana chips after dipping in sugar solution

Sample	Control	4 g	8 g	12 g
Percentage of moisture reduction (%)	86.65	86.79	88.37	90.51

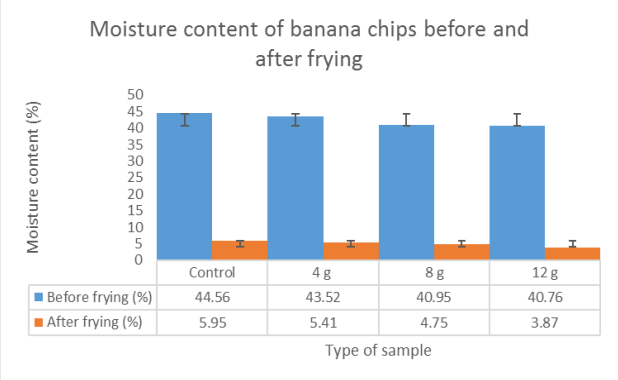

Figure 1. Bar graph showed percentage of moisture of banana chips before and after frying

three different concentrations of sugar solutions were used. The driving force for water removal is the concentration gradient between the solution and the intracellular fluid. As the concentration of sugar used for dipping was increased, the driving force for water removal was also increased and resulted in low moisture content of the banana chips.

Fat analysis

The research continues with the analysis of oil uptake in banana chips after frying. From Figure 2, the highest fat content was control banana chips (0.66%) while the lowest fat content was banana chip dips in 12 g of sugar solution (0.54%). Research by Mehta (2001) showed that fat content is largely determined by the moisture content of the food. Frying is the process of cooking foods using oil as the heating medium. In this research, deep frying techniques had been used to fry the banana chips. In deep-frying, banana chips are immersed in the oil at 180◦C for 5 minutes. During deep frying, water in the crust will evaporate and move out of the food. The banana chips with high moisture has higher amount of fat content after frying rendering chips oily in appearance thus affecting the overall preference. While a lower moisture content of banana chip led to less oil absorption, resulting in chips lacking oily taste. Similar results were also found by Smith (1951).

Lamberg (1990) stated that when potato chips are fried in oil at a high temperature, the moisture would boil explosively. This may result in cell wall bursting and damage and consequently, the formation

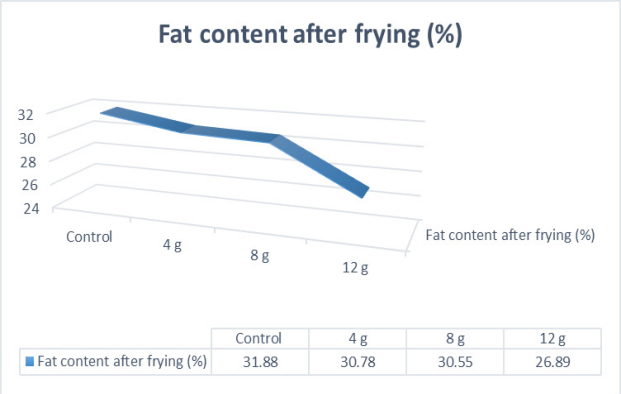

Figure 2. Percentage of fat content in banana chips after frying

of capillary holes and voids. Thus, oil adheres to the surfaces of the chips and is also absorbed into the pores or the voids in the porous slices. This is proved by data in Figure 1 and Figure 2. The control banana chips has the highest moisture content before and after frying (44.56% and 5.95 % respectively) has the highest fat content which is 0.66%. The relationship of oil uptake and moisture loss of the fried banana chips has been investigated by Southern, C. *et al*., (2000). The sugar dipped chips has much lower oil content than control samples. It was found that the sweet pre-treatment before frying is important in reducing the oil content in the chips.

Colour analysis

Next, for colour analysis, all fried banana chips were analyzed using chromameter to obtain the value of L^*, a^* and b^*. Data from chromameter was interpreted using ANOVA to determine is there any significant difference in colour between the four fried banana chips. The alpha value is set at 0.05. If the p-value is less than or equal to the alpha then the null hypothesis is rejected and there is a significant difference in colour between the four banana chip samples. All banana chips samples has < 50 for L^* value thus this indicates all samples are dark. For b^* scale, a positive value indicates yellow and a negative value indicates blue and from the analysis, all samples have positive values for b^* and indicates all banana chips have yellow color. The p-value for lightness (L^*) is 0.426 and the p-value for yellowness (b^*) is 0.468. This shows that the null hypothesis was accepted and there was no significant difference in lightness and yellowness of all four fried banana chips.

Sensory evaluation

Sensory evaluation is a scientific discipline that analyses and measures human responses to the composition of food and drink, e.g. appearance, touch,

Table 2. F value of ANOVA Single Factor using data from Hedonic Test

Attributes	F value
Colour	76.29
Crispiness	30.18
Sweetness	259.56
Oiliness	144.59
Overall acceptance	48.81

odour, texture, temperature and taste. In this research, Hedonic test were done in order to determine is there any significant difference in colour, crispiness, sweetness, oiliness and overall acceptance of four fried banana chips.

Data from Hedonic test was interpreted using ANOVA Single Factor and the F value for all analysis was showed in Table 2. The F value must exceed 2.68 to be significant at the 5% level. From Table 2, all attributes have f value exceed 2.68 and this showed that there was a significant difference in all attributes between the four fried banana chips. Sweet pre-treatment of banana chips affects the colour, crispiness, sweetness, oiliness and overall acceptance of the final product. For colour attribute, the highest scale use was 7 (dark yellow colour) and the lowest was 1 (light yellow colour).

For colour attribute, panelists are preferred control fried banana chip compared to the other samples. While for crispiness and sweetness, 12 g sample has the highest mean and control sample has the lowest. Next, for oiliness attributes, scale 7 indicates very oily and scale 1 indicates not oily. The panelists indicate control sample as a very oily chips and 8 g sample as not oily chips. And for overall acceptance, all panelists prefer 12 g fried banana chips compare to other samples.

Conclusion

In conclusion, the analysis of moisture shows that the moisture content after frying was decreased when the high percentage of sugars solution were used. There was no significant difference between the control sample and the 4%, 8% and 12% of sample for the colour measurement. The oil uptake of the banana chips were also decreased when the high percentage of treatment are used. Based on the sensory evaluation, the preferred sample was 12% of treatment banana chips compared to the control sample based on colour, crispiness, sweetness, oiliness and overall acceptance. The ANOVA analysis showed that there was a significant difference for all attributes between the four fried banana chips. Based on the experiment, the sweet pre-treatment of the banana chips help to reduced oil absorption after the frying. It is recommended during preparing the sample, the plantain banana fruits should be handling in the short time because during the peeling browning reaction also can be occurred. Another way to prevent browning reaction is dipping the sliced banana in the citric acid before dipping with the pre-treatment.

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