International Journal of Agriculture and Food Science Technology.
ISSN 2249-3050, Volume 4, Number 9 (2013), pp. 901-908

http://www.ripublication.com/ ijafst.htm

Quality Characteristics of Dried *Jahaji*banana Chips after Deep Fat Frying

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Abstract

A study on drying behavior and quality of dried and fried banana chips was under taken. Experiments were conducted at three drying temperatures (40, 60 and 80°C), four initial moisture content level (fresh, 200,100 and 5%) and five different frying % (20, 40, 60, 80 and 100 %) were taken as independent variables and product quality in terms of hardness and color were taken as dependent variables. The effect of moisture loss and oil absorption during frying indicated that drying temperature did not have any significant effect on oil content or moisture content of chips after frying. Oil absorption was maximum (68.7% wb) fresh slices and diametrical shrinkage was not significant. The color and hardness of chips change significantly during the frying period. The effect of drying temperature, moisture content, frying time on the hardness of chips significant. The Free Fatty Acid content was not significantly affected by any of the independent variables. On the basis of overall acceptability and other sensory ratings the banana chips dried at 60◦C up to 200% dB moisture content and fried for 180 Sec at 170◦C resulted at best quality of banana chips.

Keywords: Dried banana chips; oil absorption; deep fat frying; color; hardness; moisture content.

1. Introduction

*Musa assamica (*Locally called *Jahaji)* a commonly produced banana in Lower Assam and it is popular for the typical taste and flavor. Banana is probably the most popular fruit in the world and is a major fruit in international trade. All over the world banana is being processed into a wide variety of products namely banana chips, French fries, banana powder and flour, banana cocoa and coffee, alcohol, wine and vinegar. The

prospects of banana processing in India are very bright. According to a forecast by Frito-Lay (India), banana processing is expected to increases to 940 tons in 2010. Green banana is very perishable and is subject to very fast deterioration after harvesting. Air drying or sun drying is generally used for preserving it as banana chips. Understanding the drying behavior of green banana slices is therefore, important for the quality control during the drying as well as the subsequent frying process. Banana chips have a crispy and unique taste and are consumed as a snack food and an ingredient in breakfast cereals. Deep fat frying is one of the oldest cooking methods for imparting the desired texture and flavor to a variety of food products. During frying, the product dehydrates from an initial moisture content of about 90% wb to less than 5% moisture content within a few minutes of frying. During frying it losses important substances namely vitamins, minerals and flavors etc. and absorbed frying oil. Pores are formed in the product as consequences of moisture evaporation; oil uptake then occurs as the evaporation rates declines. Moisture evaporation generally causes a sharp temperature drops in the oil medium which can consequently affect the product drying rate. Deep fat or immersion frying is complex process that involving simultaneous heat and mass transfer, collection of water vapor(Bubbles) and oil at the surface of the food, physico chemical alteration of major food components and significant micro structural changes. In the view of the above, this research is undertaken with the following objectives:

a) To study the pre-drying of banana chips at different temperatures.
b) To study oil absorption & moisture loss during frying of raw and pre-dried banana chips.
c) To evaluate the quality and storage characteristics of the fried banana chips.

2. Materials and Methods

Experiments were conducted to study the oil absorption and moisture loss characteristics during frying of fresh and pre-dried banana chips.

2.1 Materials

2.1.1 Banana

The Bananas (Dwarf Cavendish) was procured from a local farmer near Kokrajhar, Assam. So as to maintain the quality of raw material care was taken to select banana having nearly uniform shape, size and without any defect on visual inspection.

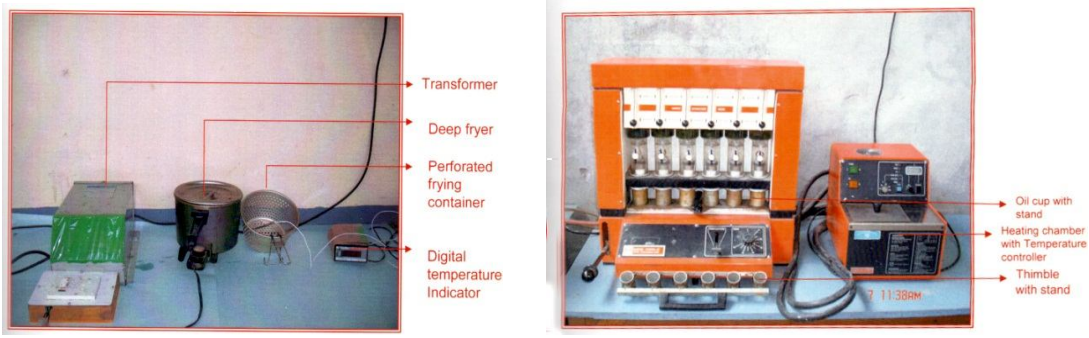
2.1.2 Frying oil

Refined Soybean oil (Brand: Fortune) was used for conducting the experiment.

2.2 Equipments

Banana slicer: Banana was sliced using a hand operated slicer.

Frying equipment: A laboratory scale Precision rice cooker (Make: RE Pabst CO, U.S.A; Model: PCS 3E) with temperature control (range: 0^0 C to 200^0 C) and perforated frying container was used as deep fat fryer. It is shown in figure (a)



(a) **(b)**

Figure: (a) Frying equipment, **(b)** Soxtec Extraction Unit

Soxtec Extraction Unit: Rapid solvent extractor (Make: Soxtec; Model: HT 1046) was used to measure the oil content of banana chips. It is shown in figure (b)

Texture analyzer: Hardness of fried banana chips was measured using a texture analyzer (Make: Stable Micro System, UK; Model: TA – Hdi).

2.4 Experimental Design

Fixed Variables	Independent Variables	Dependent Variables
Slice thickness(2 mm)	Drying temperature(40,60,80^{0}C)	Oil content
Slice diameter(30 mm)	Moisture content(fresh, 200,100,5% dB)	Moisture content
Oil type(Soybean refined oil)	Time of frying(20,40,60,80,100 sec)	Free Fatty Acid
Sample: oil ratio(1:30)		Diameter, thickness
Frying temperature(170^0 C)		Color and hardness

2.4 Experimental Procedure

The banana chips were prepared by frying of fresh and pre-dried banana chips under the chosen experimental conditions. The detail of experimental procedure is described below:

1. Fresh green banana was procured and cut into pieces of 2.0 to 2.5 cm length. Cut pieces were dipped in water before slicing.
2. Cut pieces were sliced and diameter of slices is 30 mm.
3. Banana chips were blanched with 0.1 % KMS to retain the color by preventing the browning.
4. After blanching frying was done in two phases. In first phases fresh samples were directly fried, after removing the surface moisture. Or they were pre-dried at 40^0 C, 60^0 C and 80^0 C to the predetermined moisture content then fried at 170^0 C for different frying times.
5. Fried chips were kept on blotting paper and cooled at room temperature for 5- 7 minutes.

3. Results and Discussion

Experiments were conducted to study the effect of pre–drying on frying behavior of banana chips. Statistical analysis of data in terms of ANOVA between independent variables and dependent variables was conducted using MINITAB statistical software package. ANOVA predicted the level of significance with which a particular operating variable influenced the given process. The software calculated a p- value, where the value (1-p) represented the probability at which the effect of that operating variable was significant. The lower the value of p, the more significantly that operating variables influences the particular process. In this study p- value of less then 0.05 (indicating 95 % confidence level) was taken as basis for deciding whether the effect of a particular variable is significant or not.

3.1 Oil absorption during frying

As in case of moisture constant during frying, the typical representation of the oil content on wet basis is also inadequate. Therefore the oil content was converted to moisture free basis (% mfb), along with wet basis oil content. The subsequent analysis of oil absorption is based on % oil content (moisture free basis). The figure 1 for oil content and time of frying significantly affected the oil content whereas, the effect of temperature was non-significant.(p=0.494)

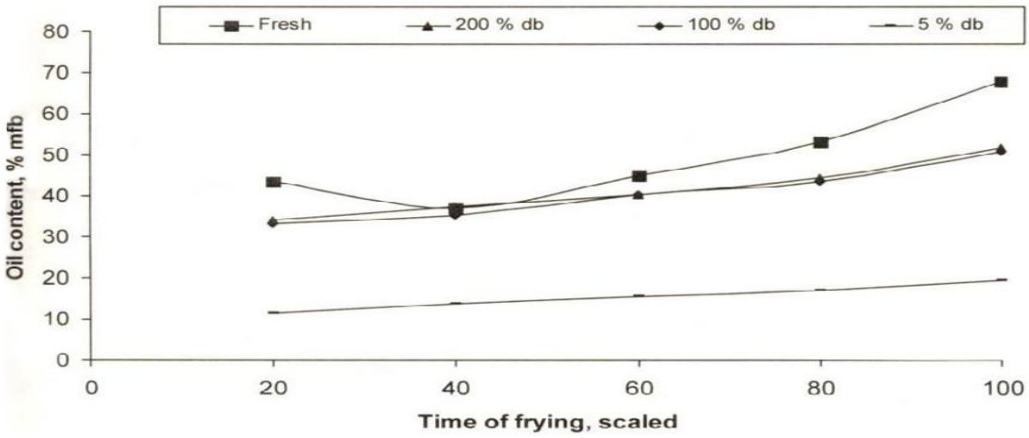


Fig. 1: Oil absorption during frying.

As the effect of pre-drying temperature on the oil content of fried chips was insignificant, the data corresponding to the pre-drying temperatures was averaged out.It can be seen that in all the cases the oil content increases with time of frying. Therefore, t_{100} corresponds to maximum oil absorption. Also it can be seen that oil absorption is maximum for fresh (un-dried) slices and minimum for the slices pre-dried to less than 5 % dB moisture content. Also as ANOVA indicated the effect of pre-drying temperature on oil absorption is insignificant. From the data it appears that from oil absorption point of view it is preferable to pre-dry the samples before frying. The banana slices pre-dried to less than 5 % dB had an oil content of 11.4 and 13.2 % mfb for 30 mm diameter chips. The same chip fried fresh has much higher oil content of 68.1 and 68.7 % mfb for 30 mm diameter.

3.2 Shrinkage

During drying product shrinkage takes place as a result of collapse of product matrix due to moisture loss, which may continue during the frying process as well. However, oil absorption during frying may, some extent, counter this shrinkage process and may even provide slight expansion.

3.3 Color

Color of the sample was specified by a color code, which ranged between 1 (lightest) and 5 (darkest). It was determined by visually comparing it with a computer generated color chart. The graph of product color changes is shown in figure 2. The graph depicts that color of fried chips was non-significant whereas moisture content and time of frying had a significant effect on color of chips.

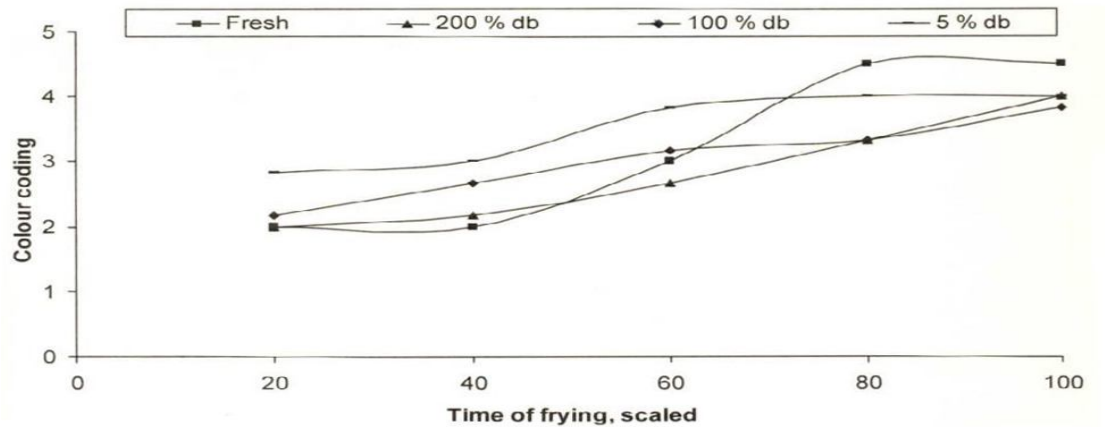


Figure 2: Changes in color during frying.

3.4 Hardness

Hardness of fried banana chips was measured using a Texture analyzer. Each experiment was repeated three times and the average hardness data is graphically represented in the figure3. The graph depicts that the effect of moisture content and frying time on hardness was significant, whereas the pre-drying temperature had non-significant effect.

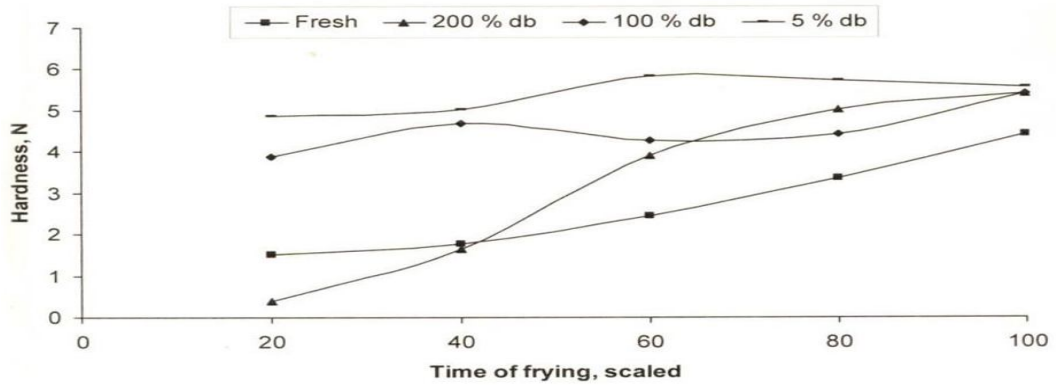


Figure 3: Hardness of chips during frying.

3.5 Increase in FFA during storage

The Free Fatty Acid (FFA) is the primary quality attribute for edible grade oil / fat. The unpleasant odor and taste which develops spontaneously in oils, known as rancidity, is of two types: hydrolytic and oxidative. Oxidative rancidity is chiefly due to the oxidation of oleic acid. The FFA value is commonly expressed as % oleic acid. The Purified Food and Adulteration Act specify a maximum acceptable limit of FFA as 1.25 (% oleic acid) for soybean oil Here we found that FFA value was not significantly affected by any of the independent variables. (**Ranganna, 2005**).

4. Conclusion

Experiments were undertaken to study the pre-drying of banana chips at different temperatures, oil absorption and moisture loss during frying of fresh and pre dried banana chips, and to evaluate the quality of fried banana chips. The experimental results were analyzed statistically using ANOVA for a simplified understanding of the influence of individual operating variables. ANOVA of moisture loss and oil absorption during frying indicated the pre-drying temperature did not have any significant effect on oil content or moisture content of chips after frying. The effect of drying temperature, moisture content and frying time on hardness of chips was significant.

Based on this study, the following conclusion can be drawn-

1. Pre-drying of banana chips prior to deep fat frying resulted in considerable reduction in oil uptake as compared to fresh.
2. Hardness of the chips increased with time of frying. Also chips pre-dried to lower moisture content had more hardness.
3. Compared to fresh chips the pre-dried chips had darker color after frying.
4. The banana chips pre-dried to 200% db at a temperature of 40◦C and fried at 170◦C for 180s resulted in best quality banana chips.

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