

STUDIES IN DEVELOPMENT OF FRUIT BASED SNACKS

Dissertation-1 Report

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CERTIFICATE

This is to certify that **SUHAIB P** has personally completed M.Sc. dissertation- 1 entitled, “**Studies in development of fruit based snacks**” under my guidance and supervision. To the best of my knowledge, the present work is the result of his original investigation and study. No part of Dissertation-1 Report has ever been submitted for any other purpose at any University.

The project report is appropriate for the submission and the partial fulfilment of the conditions for the evaluation leading to the award of Master of Food Technology.

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DECLARATION

I hereby declare that the work presented in the dissertation- 1 report entitled “Studies in development of fruit based snacks” is my own and original. The work has been carried out by me at School of Agriculture, Lovely Professional University, Phagwara, Punjab, India under the guidance of Dr. Yogesh Gat, Assistant Professor (Food Technology) of School of Agriculture, Lovely Professional University, Phagwara, Punjab, India, for the award of the degree of Master of Science in Food Technology.

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I certified that the above statement made by the student is correct to the best of my knowledge and belief.

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The national and international dietary guidance recommendations going the importance of the consumption of the fruits and vegetables and also we know that the fruits and vegetables are the cheap source of the nutritional compounds, and also international dietary guidance highlighting the consumption of low fat foods and the prevention of chronic diseases and general good health (Pierce *et al.*, 2002). But most of the population are not following these dietary guidelines so, there should need a great innovative ways to promote the healthy diets (Ammerman *et al.*, 2002). In these days it is very difficult to make healthy diets by preventing the food habits and making rules so, to make a good life habits we need to develop innovative and healthy products related to the new food habit there by we can improve or increase the consumption of the healthy and nutritious food products. There are number of studies showing that the importance of the consumption of fruits and vegetables and also the reduction of the risk of chronic diseases and non- communicable diseases such as hear diseases and some cancers. (Knai *et al.*, 2006).

The one of the main important benefits in the consumption of fruit and veg are the anti-oxidant property and their fibre content. Dietary fibre has been help to control of weight (Poskitt and Morgan, 2005), constipation, cardiovascular disease, certain cancers and diabetes (Hampl *et al.*, 2000) while antioxidants are to protecting against cardiovascular diseases and certain cancers (kaur *et al.*, 2002).Fruit were chosen for the development of the product because of the excellent nutritional significance like low in calories and fat and also good source of fibre, vitamins and minerals and anti-oxidants. And they are considered as a suitable platform from which to develop a snack for children as well as youngers, fruits contain pigments and flavour compounds that contribute to the colour and taste of the final products and children generally accept fruits rather than vegetables (Cullen *et al.*, 2001). Snacking is very famous and fast growing all over the world and all are having without considering age mainly in the eastern world. (Piernasan Popkin *et al.*, 2009). Additionally, the food sources of the snacks have changed over the years. Major shifts toward an increased intake of energy-dense snacks such as salty snacks (crackers, popcorn and pretzels), chips and nuts have occurred in combination with smaller shifts toward reduced amounts of desserts, dairy products and, particularly, fruit (Piernas and Popkin, 2009).

Here we are using banana for the preparation of snack and we are preparing banana chip as a snack. Bananas are tropical fruits belonging to the genus *Musa* and the family *Musaceae* (Pathak *et al.*,

2003). Bananas are popular and good source of nutrition and having good and nice flavour. Bananas are high energy fruit and rich in carbohydrates and also good source of potassium, iron, phosphorous, vitamin C and B6. Bananas needs 3 months from the flowering to till harvesting. The multiple number of fruits will produce on the single bunch and its weight of bunch ranges from 50-200 kg (Falade *et al.*, 2012). The maturity standards are less precise for bananas and we can determine the maturity of banana internally and externally by using different parameters. These include fruit diameter, age of the bunch, angularity of the fruit, length of the fruit, and peel colour (Demirel *et al.*, 2003). The maturity is determined by the diameter of single banana and is measuring the diameter of a banana by using pair of callipers (Falade *et al.*, 2012). Another method for estimating plantain maturity is to record the age of the bunch. The time from when the fruit bunch first becomes visible (Shooting) is recorded. A third method used to determine harvest maturity is to observe the shape (fullness) and angularity of the fruit. Immature fruit is angular in cross sectional shape and has distinct ridges (Falade *et al.*, 2012). As the fruit matures, it becomes less angular and more rounded or full. The degree of roundness differs between cultivars and location of the hand on the bunch (Demirel *et al.*, 2003). The fourth method to determine the maturity is to measure the length of the edible portion of banana in the middle of bunch. The length should be 15cm for the domestic market and 18cm for the export market (Demirel *et al.*, 2003). The fruit colour is the frequently used method to determine maturity, the peel colour will be in green colour throughout the growth and maturation and its colour will change to yellow during ripening stage (Falade *et al.*, 2012).

Generally, bananas we can have as raw, ripened and when it ripens it will get deteriorate fast because it will be more perishable when it ripened. That's why bananas need post harvesting methods to prolong the shelf life of the fruit. In this way we can decrease the huge economic loss, and it can be preserved by the different methods such as drying and frying (Mohapatra *et al.*, 2011). Most of the people are consuming the bananas as raw, steamed or boiled and also banana get ripe easily and it will be huge waste in food industry. And there is one method to reduce the spoilage is the production of banana chips and normally banana chips are prepared from raw bananas by deep fat frying in the oils like coconut oil, palm oil etc. and it will be in dry form. Deep fat frying is the conventional frying method and it is the immersion of slices in the oil at the temperature 110-160°C it will be in dry form comes frying. This higher temperature cause evaporation of water from the slices and it will be replaced with oil (Troncoso *et al.*, 2009). The majority criteria for the commercial quality determination of the chips are visual colour with respect to the coast and consumers preference (Abdullah, 2014). And also for the preservation packaging and storage condition are the most important. Storage stability depends on packaging. Good packaging and storage condition extend the storage life of chips.

The snack with fruit is more acceptable and we know that the fruits are rich in nutrients. However, the main problems facing the fruit based snacks are high fat content and low stability/shelf life. The higher fat content in the product will bring unfavourable changes in the flavour, odour and other general organoleptic properties and especially having less shelf life of the product because of the oxidation and also cause chronic diseases. So we have to develop a fruit based snack having low fat content with long shelf life and stability and improved organoleptic and other properties by examining the effects of blanch temperature and blanch time on crispness of banana chips. Response surface methodology is then used to determine optimum conditions for producing crispy chips using under ripe bananas.

The present study is based on the development of the fruit based snack using banana with enhancing the shelf life, stability and improved organoleptic and other properties. This chapter describes the review of related research and development in the past few years.

The banana chip production mainly by the conventional process deep fat frying. The slices of the banana are embedding into the vegetable oil at higher temperature ranges from 110°C to 160°C and it cause drying comes frying. The higher temperature cause the evaporation of the moisture in the slices to the oil and oil will replace the some of the lost water (Troncoso *et al.*, 2009). During frying process there some modification will occur in the physical, chemical and sensory characteristics. Banana chips are prepared from the under ripened bananas and it is very famous in the different parts of the world. And the acceptance of the banana chips based on the quality attributes of the product (Wani *et al.*, 2017).

Snacks

The consumption of the snacks increasing day by day in this last decades and it will increase further more in the near future also. The doubtful change to the consumption of snacks are changed the intake of dietary pattern and which cause the chances of the obesity (Zizza, *et al.*, 2001). Peoples are not eating continuously and eating is episodes, which means the intake of the food consumption will change according to the time, history and culture (Meiselman, 2002). In the modern developed societies we can differentiate the meal and snack. Meal is the three time eating per day like breakfast, lunch and dinner. The term snack is the other food items includes all food drinks except the main three time eating per day (C. de Graaf 2006). Most of the snack in the modern world having higher amount of energy. Sweet snacks like cookies, cakes, pies, ice cream, and chocolate candy bars contains high amount of fat and sugar and the average amount of energy content ranges from 1500 to 2000 kJ/100 g (NEVO, 2004;Whybrow, 2005).

The snack foods include coffee or tea, milk products, bread, water, sweets, meat or fish, fats, sweet bakery goods, fruits or fresh vegetables. Sweet bakery goods (14%), bread (14%), alcoholic beverages (13%) and milk products (12%) in men, and sweet bakery goods (18%), bread (14%), milk products (12%) and sweets and chocolate (19%) are snacks cause more energy intake. The

consumption of snack causes higher energy intake so it affects badly the intake of meal, the snacks dominating the meal pattern (Ovaskainen *et al.*, 2006). Ready to eat crispy snacks from the dried products seems to be interesting because of their enticing form and taste and also containing higher amount of nutritional value. A snack is a part of the food smaller than the meals eating between the meals and also with the meal. Snacks should contain nutritional value, it should be healthy, easy to eat with excellent taste and provide higher energy (Odedeji and Oyeleke 2011)

Fried snacks

Fried food products are mainly popular as snacks and based on the raw material they are different and also varies according to the size, shape and composition and all are preparing by the deep fat frying using vegetable oils in a very large proportion. Fried snacks having very less amount of moisture content and we can store at the room temperature. The main cause of the spoilage of the development of off flavour and rancidity due to the fat peroxidation (Sharma *et al.*, 2000)

Deep fat frying is the main process commonly used for the snack manufacture in terms of commercially and house hold level. Fried foods are the main sources of fat and energy with improved digestibility. Fried foods having very low level moisture content which improve the stability and shelf life and also can store at ambient condition. Frying imparts characteristic colour, flavour and crispy texture to the product (Ravi and Susheelamma 2004). Texture is the one of the main characteristics strongly influence by microstructure of the fried product (Du and Sun 2008; Zheng *et al.*, 2006). The shelf life of the food products are mainly depends upon the storage atmosphere such as temperature, humidity, light etc. in the case of fried snacks the rancidity affects the acceptability of the product. The important parameter causes of the fried snack is crispiness, it will get poor texture due to sogginess and thus poor acceptability of the product.

Fruit based fried snacks

Numbers of fruit based snacks are available in the market currently and are developed by frying in cooking oil. Snacks containing higher energy level and fat causes obesity amidst the children (Jahns *et al.*, 2001) and also it will cause additional chronic diseases such as hypertension, diabetes and cardiovascular diseases ((Kavey *et al.*, 2003) For example the apple based crispy snack prepared by frying at high temperature (110°C) for long time (25 min), however it caused 39% oil and also cause non enzymatic browning in the fried apple slices (Shyu and Hwang, 2001). Due to these reasons we need to avoid the absorption of oil with improved nutritional property, so we can use drying process

as an alternative for the frying process (Sham *et al.*, 2001). Frits are impregnated with the sugar solution and it can attain the characteristic improved texture, taste and higher shelf life by the process of drying (Martinez-Monzo *et al.*, 2000). Fruits and vegetables have high nutritious value and containing higher sugar content and these are heat sensitive, so it will get lose due to usual frying temperature and its natural colour and flavour also will get lose if not frying process takes place at lower temperature (Shyu *et al.*, 2001). To preserve all of these higher nutritional values and produce crispy product with fruit flavour we have to use vacuum frying because the frying takes place in this method (Escalada *et al.*, 2007). In recent days consumers trending towards the healthier and low fat products and it much more impact on the snack industry (Dueik *et al.*, 2010). Fruits and vegetable snacks are the ready to eat product can help the population to improve the consumption of fruits and vegetables (Dueik and Bouchon, 2011).

Nutritional properties of banana

Table: 1 proximate analysis of banana cips

TYPES OF CHIPS	Moisture%	Ash%	Protein%	Fat%	Fibre%
Unripe banana	71.20	2.25	4.41	2.25	4.50
Baked banana chips	11.48	3.25	3.14	3.25	8.50
Fried banana chips	3.55	10.50	3.49	10.50	10.00

Source: *Elkhalifa et al. (2014)*

Table: 2 Proximate composition of (%) banana flours

Verity	Moisture	ash	Fat	Protein	Dietary fibre	carbohydrate
Monthan	8.4	2.54	0.75	1.45	1.7	85.76
Poovaan	7.7	2.40	0.25	1.05	2.0	86.00
Karpuravalli	8.3	1.20	2.06	3.25	1.8	83.79
pachai	7.3	2.80	1.82	1.73	1.0	83.75

Source: (P. Selvamani et al.,2009)

Minerals content

Table: 3 Minerals Content of Banana Chips

Ttypes of chips	Calcium mg/100g	Phosphorous mg/100g	Iron mg/100g	Sodium mg/100g	Potassium mg/100g
Unripe banana	24.40	96.80	2.44	2.20	230.00
Baked banana chips	11.60	136.00	1.50	2.75	57.50
Fried banana chips	10.40	97.65	2.21	2.70	102.50

Source: (Elkhalifa et al., 2014)

M MWall(2006) determined the ascorbic acid for bananas harvested from 66 plants and he reported that he can't detect the dehydroascorbic acid(DHAA)even at 214 nm wave length. Wimalasiri and Wills (1983) detected 1.4 mg DHAA/100 g using UV-Vis at 214 nm. Vanderslice et al. (1990) measured 3.3 mg DHAA/100 g in bananas using fluorometric detection, and 2.6 mg DHAA/100 g in papayas using a UV-Vis detector. M M Wall(2006) observed that the amount of vitamin c content in

the Dwarf Brazilian bananas was almost three times higher (12.7 mg/100 g) than the vitamin C content of Williams fruit (4.5 mg/100 g). Dwarf Brazilian bananas (100 g) would provide 14–17% of the US DRI for vitamin C for the average adult

M M Wall(2006) reported that the average vitamin content in the dwarf Brazilian bananas was 1.5 times greater than Williams fruit. Dwarf Brazilian bananas had 96.9 mg b-carotene and 104.9 mg a-carotene/100 g, whereas Williams fruit averaged 55.7 mg b-carotene and 84.0 mg a-carotene/100 g. Also, bananas contained higher concentrations of lutein than the pro-vitamin A pigments (M M Wall,2006).

Blanching

Blanching is the one of the best treatment in processing of fruits and vegetables because of the advantages can be obtained. An important advantage of the blanching is preventing enzymatic browning and all the enzymatic degradation by the inactivation of enzymes in the fruits and vegetables. However, blanching has also resulted in increasing the drying rate of products (Rittirut et al., 2012).blanching in fruits and vegetables helps to inhibit the formation of bad flavour in appropriate storage (Krokida et al., 2000) .blanching includes the steam and hot water treatment for a short time period. The objectives of the blanching are to bring the favourable effects on the processed materials, the inactivation of enzyme present in the material, removal of the trapped air in between the cells, hindering of the possible initial microbial contamination, prevention of the formation of undesirable flavour and aroma. During the blanching of the fruits and vegetables time and temperature are dependable on the inactivation of enzymes.

Krokida et al. 2000 reported the effect of pre-treatment in the fruits and vegetable, the browning due to enzymatic and non-enzymatic reactions. The relative stability of the colour parameters are due to the infusion of the sugar during pre-treatment. The blanching by hot water and steam are also cause the relative stability of the colour parameters. R. Dandamrongrak et al.2003 the initial drying rate was quick for the blanched samples since sample absorbed the moisture content during blanching and cooling.

Dandamrongrak et al.,(2003)reported that when we are comparing both the blanched and un-blanched, blanched product is more firm than the un-blanched having equal moisture content(38%).the firmness values of the treated and untreated intermediate moisture banana are 120-220 and 4450-550 lb respectively. When we are comparing the colour values of the blanched and

non-blached products, for the blached product the value of colour is higher it means the prevention of darkness increasing with increase of the blanching temperature up to 5min.if the blanching time increased the (6-7 min) value of colour decreases it means the product will get darker quickly during drying.

Dehydration

Dehydration or drying is the one of the oldest and developing method for the food preservation and also extension of the product quality such as nutritional value, flavour, aroma, colour and structure. There are different types of the drying methods like conventional and modern methods like solar drying, hot air drying, vacuum drying and microwave drying etc. The highest sugar containing fruits like banana needs higher temperature for long time to reach safe moisture during drying. This long time may cause the loss of flavour, colour, nutrients and decrease bulk density and rehydration capacity of the final product. There are different dehydration methods offers advantages over the conventional drying methods (Tavakolipour et al. 2009).

Tavakolipour et al. 2009 reported that the drying of banana over conventional drying have number of advantages, the amount of moisture present in the sample is directly affects the amount of microwave absorption and in the initial stage of drying loss the dielectric factor increases the higher amount of water and the moisture content will be lower at the final stage with influence of specific heat on heating process. Therefore foods with low moisture content will get dry due to low specific heat in acceptable rate using microwave.

Vacuum microwave drying is an another way to improve the quality of dehydrated product and retain the thermal sensitive volatile compounds and oxidation. In vacuum microwave drying for the rapid heat transfer microwave supply energy and vacuum lowers the boiling point of the water in the drying food sample and this process vaporise the moisture at the low temperature so, it will decrease the thermal damages to the food product and also vacuum remove the oxygen and it suppress the oxidation and preserve colour and flavour of the dried sample (WINNIE et al.2002).

Hamid Tavakolipour and Leila Zirjani 2014 reported that in the comparison of the drying rate of both the hot air drying and microwave drying, the average drying rate of the hot air drying is 0.012 (kgw/kgs.min) and 0.12(kgw/kgs.min) rate of microwave it means the rate of drying of microwave is ten times greater than the rate of hot air drying. Due to the drying the colour of the sample get decolourise from yellow to brown when temperature increases with increase in time due to milliard reaction in hot air drying and also discolouration occurs due to high power of intensity. And also

they observed that the increase of temperature in hot air drying and microwave power intensity decreases the sugar content in the banana sample, the amount of sugar in the fresh banana is 2.26 mg/100g and hot air dehydrated sample shows average 10.36 mg/100g and microwave dehydrated sample average 6.64 mg/100g. So the rate of loss of sugar content at microwave drying method is higher than the hot air drying method.

Blending of frying oil

A.S. Bhatnagar et al., (2009) reported that the blending of coconut oil with other vegetable oil for the coconut oil consumers as frying oil the composition of free fatty acid enriched with monounsaturated fatty acid and poly unsaturated fatty acid from the range of 6.1 and 1.2 per cent to the range of 7.9-36.3 per cent and 4.4-35.6 per cent respectively. And the free fatty acid composition in blended oil for the non-coconut oil consumers is enriched with medium chain fatty acids(MCFA) and refined, bleached, and deodorized coconut oil (RCNO) are also enriched up to 11.3–13.2 per cent.

The natural antioxidants present in all the vegetable oil is tocopherols, oryzanol in rice bran oil(RBO) and lignance in sesame oil(SESO). The role of antioxidants such as oryzanol in RBO and lignance in SESO are not individually specific in the scavenging DPPH radicals. The total tocopherol content in the coconut oil blend for the coconut oil consumers is increased in a better way from 29 in coconut oil to 111–582 mg/kg in the blended oil so there is a better increment in the scavenging DPPH activity by the range of 5.5–33.4 per cent. But in the case of the blend for the non-coconut oil consumers the tocopherol content is lesser in blended oils than the individual oils by 20-25 per cent (A.S. Bhatnagar et al.2009).

Antioxidants

Antioxidants are the substances which adding in to the frying media to improve shelf life of deep fried snack food products(Stuckey, 1968). Antioxidants can inhibit or prevent the action of oxidants in both the humans as well as food products. The prevention of the oxidation in humans and food products is based upon the basic principle of anti-oxidant protective technologies. Oxidation is the chemical reaction which occurs due to the transfer of an electron to the oxidising agent. These oxidation reactions will produce free radicals, which will start the chain reaction by binding the oxidation molecules by free radicals as binding agent. Antioxidants will break off this chain reaction by the removal of the free radicals and other oxidation caused by oxidising themselves.

Antioxidants are classified into primary or natural antioxidant and secondary or synthetic antioxidants. Primary or natural antioxidants will react with lipid radicals and convert into more stabilised product by breaking the chain formed by the free radicals (Hurrell, 2003).secondary or artificial antioxidants such as Butylated hydroxy anisole (BHA), Butylated hydroxy toluene (BHT), Propyl gallate (PG), metal chelating agent (EDTA), Tertiary butyl hydroquinone (TBHQ),and Nor dihydroguarcetic acid (NDGA).

Noor and Augustin (2006) found that the result of the addition of antioxidants on the stability of banana chips and he observed that the chips by BHA or BHT containing refined bleached and deodorised olein are more stable than the fried chips using refined bleached and deodorised olien without antioxidants.

There are several literature reports about the preparation of banana chips with different methods. To the best of our knowledge very few researcher reports are available which have focused on the stability of frying oil.

This study deals with:

- Optimization of blanching process – Conventional/Microwave
- Optimization of drying process – Hot air/ vacuum/ microwave
- Microwave frying (optimize process parameters: frying time, temperature)
- Quality characteristics of pre and post-fried banana chips
- Quality characteristics of frying oil (effect of blending of different oils)
- Effect of hydrocolloids on pre and post frying quality of banana chips (alginate, CMC and pectin)
- Effect of antioxidants (BHA and BHT) on stability of banana chips.

Proximate analysis:

Proximate analysis (Moisture, ash, protein, fat, fibre and carbohydrate content) is determined as per the standard method of AOAC (2005).

Physicochemical analysis:

Colour and hardness are determine the method given by Wani *et al.*, 2017

Free Fatty acid value, peroxide value, anisidine value, iodine value and total oxidation (totox) value are determine by the method given by Diana *et al.*, 2012

Ascorbic acid determine the method given by Dandamrongrak *et al.* (2002)

Total sugars are determine the method given by Hamid Tavakolipour and Leila Zirjani 2014

Phytochemical analysis:

Phytochemical analysis (total phenolic, total flavonoid, trolox antioxidant activity) is determined as per the method given by Bhatnagar *et al.*, (2009)

Sensory analysis

Sensory analysis will be by the hedonic scale as per given by Wani *et al.*, 2017

- Fruit based snack will be prepare having improved shelf life.
- Fruit based snack will be prepare with improved organoleptic and other properties.
- Low fat fruit based snack will be prepare with more stability.

Work plan	Jan- March	April- June	July- Sept	Oct- Dec	Jan- march	April- june
Topic approval	√					
Literature review	√					
Product standardization		√				
Product development			√			
Product Analysis				√		
Result compilation					√	
Thesis writing and publication						√

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