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A REVIEW ON PRODUCT DEVELOPMENT THROUGH PULP AND PEEL OF BANANA

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ABSTRACT

Banana is the most important tropical fruit belongs to the family Musaceae, genus Musa. They are native to tropical Indo-Malaysia and Australia. It is herbaceous plant and grown in wide range of environment. 107 countries are growing bananas. 40% of the fresh weight of the banana is represented by its peel.18.33% of the fruit was peel part which are of waste product. Banana peel consists of phenolic constitutes. Banana is a fine source of dietary fibre, proteins, essential amino acids, polyphenols, carotenoids, potassium and polyunsaturated fatty acids. Lipid oxidation in the food products was prevented by antioxidative property of polyphenols which causes randidity in food products. Peel and pulp of banana were used for the evolution of products like bread, cakes, noodles flour, gluten free products etc. extracts of banana peel would be functional l to conflict free radical moderated illness. Antioxidant property of polyphenols also help in preventing off flavour, which show reduction of shelfing and nutritive value of food.

Keywords: Ethanol, xylitol, peel flour, gluten.

Introduction

One of the most important commercial tropical fruits traded was banana. It belongs to the family Musaceae and genus Musa. It can be grown in varied range of environments. It was evolved in varied range of environments. It was evolved in south east Asia, New Guinea. Banana is an herbaceous plant and grows in wide range of environments. Banana exports lead in the central America and northern south America region (TENET). 106.34 million tonnes (mt) of banana world production was seen in 2004. This was overreach among fruit crops by sole citrus (110.91mt). 5.2kg of banana per person was consumed as annual consumption in 2001 yet it was 5 times more in 28 countries of 162 nations. Largest producer of banana is India contributing 27% of the worlds production. In production maximum positive growth rate noticed in Gujarat (13.37), least in Maharashtra (-0.06%). Leading producer is Tamilnadu followed by Maharashtra largest agricultural commodity standing in fifth position in world trade after cereals, sugar, coffee and cocoa is banana. Banana grown widely in the world with 20.8mt/ha productivity.

Bananas are rich in fibre, vitamin C vitamin B6, potassium, phytonutrients and several antioxidants. Carbohydrates occur as starch in raw bananas were as sugars in unripe bananas and sugars in ripe bananas up to 80% of starch is present in green banana measured in dry weight. Sucrose, fructose and glucose are the sugars present beyond 16% of the fresh weight in bananas that are ripen. 42-58 of glycemic index (GI) is relative low in banana, high content of resistant starch and fibre explains their low GI. Bananas consists of sum total of minerals and vitamins inappropriate amounts. These comprises vitamin C, B6 and potassium. It also contains anti-oxidants. 125gm is the average weight of the banana with nearly 75% water and 25% dry matter. The banana peel is around 30% (w/w) of fresh bananas. Ripe banana peel comprises about soluble sugar (13.8%), coarse protein (8%) and ether extracts (6.2%) and phenolic compounds (4.8%). Largest producer of banana production is India.9pathak *et al*., 2017). 40% of the total mass of fruit is represented by peel of banana (Anhwangl *et al*., 2008). Banana peel consists of phenolic compounds in the range between 0.90 to 30g/100grams dry weight (Somaya *et al*., 2002 and Nguyan *et al*., 2003)

Anthocyanin, cyanidin and delphinidin (Seymour, 1993) are phytochemicals and catecholamines (Kanazwa and sakakibaran, 200) these all are present in both pulp and peel of ripe banana Phenolic compounds are present in higher concentrations in peel of banana in contrast to pulp of banana (2005, Someya *et al*., 2002; Sulaiman *et al*., 2011; Fetemeh *et al*., 2012). Banana peel contribute hazard to the environment as these are dumped in large expense. These peels are not contributing to any processing process, but significantly we can find applications on these banana peels as they are rich in fibre, vitamin C, vitamin B6, magnesium and potassium on the other hand sugar, calories and fats are low in concentration in peel.

Potassium is found in excellent quantity in banana which provides 23% of the potassium that we need on a daily basis. It helps to decrease blood pressure. Banana peel is good source of carbohydrates and fibres. The vitamins present in banana keep the body healthy in many ways. If you have weather blues or suffering from PMS banana will help in improve your mood. Due to higher fibre content in peels, it cures constipation and helpful in curing diarrhoea and dysentery. Worm problems in kids are believed to be reduced by bananas. Gallo catechin is present in banana peel at a concentration of 160mg/100g DW (Someya *et al*., 2002). about 20% of sugar is present in banana and fair source of vitamin B and calcium. It provides about 116 Kcal energy/100gm of ripe banana. It reduces the blood pressure

and stroke. Leucocyanidin is a flavonoid that increase the thickness of mucus membrane in stomach and protects from ulcers and heartburn, kidney effect, hang over (Kumar *et al*.).

Ripening and growth stages causes variations in polyphenotic content. Polyphenolic compounds have anti oxidant properties. peel of banana consists of higher amount of phenolic compounds. Antibacterial, antiviral, anti allergenic, anti-inflammatory and vasodilatory activities are exhibited by phenolics (Cook and Sammon, 1996). Complete phenolics and antioxidant properties are high in pulp extracts with a few exceptions than the pulp. The main ingredient found in both the pulp and peel of banana is potassium over phosphorous, sodium and magnesium. Food uses of bananas are chips, juice, puree, dried flour for bakery, fermented and unfermented beverages. Functional properties and storability of these processed products may be altered by the various innovative application on food processing technologies. Banana is a perishable fruit, by processing many products can be made from it. Reduction in weight and volume in banana can be bring by drying which minimizes the packaging, transportation cost and storage. Dried fruits are tasty and nutritious can be eaten as snack or added to make other products like cereals, muffins and ice cream (Eisey *et al*., 2007 and Reynolds, 2007). During drying there will be internal collapse of the particulates, water removal (Senadera *et al*., 2005), shrinkage, outer dimension changes. This study describes the utilization of pulp and peel of banana for expansion of various products and its phenolic compounds.

Polyphenolics and antioxidant activity of banana pulp and peel

Polyphenols act as antioxidant Properties as peel of banana is rich in polyphenols. Total phenolic compounds reported from 0.90 to 3.0g/100 dry weight of banana peel. Catechin, Gallic acid, tannins, epicatechin and anthocyanins are various phenolic compounds than that of banana pulps. Beta carotene, α-carotene and beta -cryptoxanthin are carotenoids which have provitamin A activity which are present in banana fruit, lycopene and leuteinposses apowerful antioxidant capacity (Erdman *et al*., 1993). Rancidity, polymerization and off-flavour compound in food components is caused by lipid oxidation which is undesirable and conduct reduction nutrition value and shelf life of food so to lower the worsen of lipids in several industries are depending upon synthetic antioxidants such as propyl gallate (PG), 2, l6-di-terl-butyl-phydroxytoluene (BHT), tertbutyl-4-hydroxyanisole(BHA) to extend the shelf life of the products. Synthetic antioxidants may lead to the health hazards. So natural anti oxidative compounds are desirable. Varied types of fruit by-product with properties of antioxidants are identified, For viz. banana peel leavings (Gonzalez-Montelango *et al*.,2010) have been assessed as an economic antioxidant sources . 2,2-diphenyl-1-picryhydrazyl (DPH) and 2,22-azino-bis(3-ethylbenzo thiazoline)-6-sulfonic acid, free radicals had a high capacity to scavenge and also good lipid peroxidation inhibitors. Dopamine and 2-dopa, catecholamines have a antioxidant activity present in banana peel.

Different types of banana peel products:

i) Xylitol from banana peel: from the reduction of xylose, xylitol is obtained which is known as birch sugar. It is rare sugar and an alternative to conventional sweeteners. Xylitol was naturally build in fibre of several fruits and vegetables like oats, berries and husks of corn etc. These are found in very low concentrations and having sweetness level same as like to that of sucrose. Xylitol had no or few calories . it is absorbed very slowly compare to sucrose. used as a substituition for sugar to treat diabetic patients as it metabolizes independent of insulin. Xylitol is produced from lignocellulosic materials as it serves the purpose of the substrate for production of xylitol. Cellulose, hemi-cellulose and lignin are the major components of lignocellulosic are 6-12% lignin, 7.6-9.6% cellulose and 6.4-9.4% hemi cellulose are present in banana peel. (Debabandga *et al*., 2010)

Peel of banana is utilized as a substratum for xylitol. (Rehman *et al*., 2013). 18-20% of the banana it its peel as it is taking into consideration as a wastage. It is a fine source of lignocellulosic compounds and 91% of matter that is organic is present among which carbohydrates is 59% (Anhwange 2008). It is vital to pay consciousness to use peel of banana as a xylose, sucrose and turn it into a added value product: Xylitol. In confectionary industry xylitol has its applications. Specially for products that are sugar free. It can also be used in diabetic products. It is abundantly used in candy products. Soft drinks, chewing gum etc. (Aminofb *et al*., 1978). It is used in the rusks preparation by placing xylitol in place of sucrose. At distinct intervals physicochemical study of rusks was carried out in storage conditions.

(ii) Ethanol from banana peel:

Major energy source is the fossil fuels world wide, use of this is associated with global warming, urban pollution and depletion of reserves, climate change. Fossil fuel is non-renewable and non-evenly distributed within nations. In this sense ethanol derived from plant based materials act as an alternative fuel for spark ignition engines. Fossil fuel sources are rapidly disappeared due to high industrial growth and cost of petrol, diesel and increasing. So scientists move towards renewable energy sources, among them is biofuel. Biodiesel and bioethanol are the examples of biofuel. Ethanol is biodegradable and sulphur free. It is also called as alcohol which is colourless, volatile liquid, flammable. It avoids contribution to co2 rise in the atmosphere. It is widely used as a fuel and as a raw material for other useful chemical production that have wide application in the industry. It catalyse the agricultural productions. It can also be used for household purpose, applied as an antiseptic. Useful in latex processing and phytochemical applications, preparation of mouth was, cough syrup other disinfectants and also constituent of pharmaceutical. The use of lignocellulosic biomass is an alternative for bioethanol production. Biomass includes residues from forest, agriculture, industrial etc. Sugarcane bagasse, newspaper sugarcane molasses are various substrates that are previously used for production of bioethanol. By rapid utilization they are disappeared so it is time to find new substrate. Banana peel is one of them along with its residual biomass i.e., amylaceous and lignocellulosic compounds. It is hydrolysed initially to convert into glucose used as feedingstuff and to manufacture ethanol by fermentation process and distillation.

Nutrient composition of banana peels

The banana peel contains following nutritive elements. Concentration are written in parenthesis. These elements are Potassium (78.10 ± 6.58mg/g), Calcium (19.20 ± 0.00mg/g), Sodium (24.30 ± 0.12mg/g), Iron (0.61 ± 0.22mg/g),

Manganese (7.20 ± 0.00mg/g), Bromine (0.04 ± 0.00mg/g) Ranzani *et al.* (1996) and Anonymous *et al*. (2001&2005).

(iii) Banana peel flour:

Pulp and peel are the two parts of banana. Peel is the by-product and it is around 40% of whole weight of the fruit. peel of banana has high fibre content and high levels of bioactive compounds. biological and chemical assessment of peel of ripe banana was conducted by Ranzani *et al*. (1996). Banana peel flour has long preservation potential and long lifetime. Banana peel flour can immediately applied to food stuffs. By using a spouted drier for green banana flour production it has resulted in high dietary fibre and starch resistant with an average of 21.91% and 68.02% consequently. alkaline yellow noodles were made by limited replacement of wheat flour with flour of ripe banana pulp and peel. Cavendish Banana pulp and peel flour is reported as it can be utilize for managing starch hydrolysis of noodles. studies have conducted by feeding the rats with addition of peel flour to its diet, it dropped its digestibility of protein and faecal bulk was raised. The growth of rats fed with control diet. From green and ripe cavendish pulp and peel flour of banana was produced and were evaluated for properties of physicochemical such as TSS (Total soluble solids), pH , Water holding capacity (WHC), Oil holding capacity (OHC) at 40, 60, and 80 degree centigrade. black extrusion force (BEF), colour values and viscosity by alkarkhi *et al.* (2011). Analysis of data were obtained by MANOV, quality analysis and aggregate analysis. Physicochemical resources of pulp and peel flour of ripe and green banana were distinct from one another.(Alkarhi *et al*., 2011).

(iv) Pulp and peel of green banana flour pasta and noodles:

Banana peel has high dietary fibre content as it would be utilized the peel ingredient as useful ingredient in products rich in starch. Production of banana peel flour and investigation on banana peel were studied by Ramani *et al*. (1996). Ripen stage will effect on the dietary fibre containing constituent and pectin of banana's peel. (Emaga *et al*., 2008) and chemical constitution was affected by the maturation phase and banana varieties.

Banana flour has a acceptable potential as useful ingredient for cause of special foods. Castelo *et al*. (2017) prepare agilatelle pasta by substituting the flour of wheat with mixed pulp and peel of green banana flour in two different clusters 15% and 30%. A control composition was also prepared with wheat flour. Higher ash, total phenolic compound and total fibre content was found in green mixed flour of green pulp and peel than the traditional wheat flour with compulsion of 15% flour of banana the pasta formulation showed more amount of f ash and good sensory acceptance of all formulations.

By limited substitution of flour of wheat with ripe banana peel and pulp flour noodles were made by Shaifullah *et al*. (2009). Flour of peel have more dietary fiber but it is low in resistant starch constituents than the flour of the pulp. Predicted glycaemic index (PGI) was low in noodles of banana peel flour mostly due to high point dietary fiber matter. Peel flour was assessed of parameters such as colour, elasticity, pH, tensile strength estimated glycaemic index (GI) and in-vitro hydrolysis index (HI). BP noodles was found to have higher tensile strength and elasticity modules and darker and less yellow than control noodles. Invitro starch hydrolysis studies found that the glycemic index of peel noodles of banana were underneath than control noodles.

(v) Banana peel flour cake

Gluten is present in wheat and other grains such as barley, rye and oat which causes celiac disease by the consumption of the gluten. The at most care for celiac disease is diet that is free from gluten. Many gluten free nourishment products are available in market wealthy in starch yet they are low in terms of added nutrients and other strength beneficial elements. Reliable source of resistant starch, polysaccharides that are non- starch comprises of dietary fibre is green which also contains polyphenols, antioxidants, essential minerals (Turker *et al*., 2016)

Turker *et al*. (2016) developed gluten free nutrious cake from substituting the rice flour with green banana flour (GBPF) AT (5 percent, 10 percent, 15 percent and 20 percent) and to look over physical possessions of green banana peel flour substitution cakes. Gluten free cakes prepared from substitution of GBPF were successfully placed 5% and 10% substitution of GBPF to gluten free cake do not effect the physical analyses of cake of gluten free like quantity, density, specific capacity and baking loss adversely. Proper physical properties were resulted by substitution of GBPF at levels of 15% and 20% sensory analyses shown that all GBPF replacing levels were reliable as decided by hedonic scale

(vi) Banana peel flour cake donuts:

Mutia *et al*. (2018) prepared cake donuts. The aim is to realize the best formulations of the wheat flour and banana peel flour concentration to the best of organoleptic wheat flour and banana peel flour formulations favoured by panelist was banana peel flour nearly 75% and flour of wheat is approximately 25%. Value test product nutrient among is ideal to water content 17.52%., 1.14% was ash content and protein was 17.23% and carbohydrate 18.52%

4. Different types of banana pulp products

(i) Banana flour

Post harvest losses of banana can be minimized by using banana flour as an alternative excellent source for retain the nutritive value of fresh bananas. Dietary fibre and resistant starch are rich in unripe banana flour and it aids in colon health. Hugel amount of iron, potassium, calcium and reducing sugars that helps ingood circulation of blood are found in ripe banana flour which helps in blood circulation. Banana flour is often used raw. For example as an ingredient in smoothies or nutritious bars, because cooking reduce the resistant starch content and from unripe banana cookies are prepared from ripe banana flour bread is prepared

Physio-chemical, re-constitutional and sensory qualities study were conducted by Singham *et al*. (2014) on prepare ripe and unripe pulp of banana were assessed at the storage of 60 days at environment conditions. Unripe banana flour has greater water holding capacity than ripe banana flour. Flour if ripe banana were more dried than the banana that is unripen. It was cleared by FTIR spectroscopy. On account of existence of sugar in flour of ripe banana its hygroscopicity seemed much greater than unripe banana flour.

Neutraceutical ingredients development is of present day interest for industries of food products. Powder rich in fiber was made by liquefaction of RBF (Raw banana flour) was done by Rodriguez *et al*., (2008). And its oil and water holding capacity, chemical composition and capacity of antioxidant were evaluated. Fiber rich powder has higher dietary fiberb (HDF) in comparison with raw banana flour (RBF). Yet the potentially AS (Available starch), total starch (TS) and (RS) Resistant starch content were poorer in the products that are processed, because the granular interuption and starch hydrolyze were involved bin the liquefaction process evolving in the decreased TS and available starch and increased total dietary fiber. The resistant starch content reduction is also determined by granular integrity lack, which one is the key factor accountable for the native banana starch indigestibleness. In FRP total indigestibility fraction content was lower than the insoluble portion. In presence of FRP a very speed reduction of DPPH was seen showing that polyphenols in this manufacturing effectiveness quench free radicals. At different climate conditions the RBF FRP shown same oil and water holding capacity at 80 degree centigrade , the major variation was seen in water holding capacity (WHC) where FRP was low competency with starch gelatinization in ripe banana flour treated at that point of temperature for expansion of products with high total dietary fibre and indigestible fraction content FRP might be a potential ingredient as well as important antioxidant capacity.

(ii) Banana bread

Ripen banana helps to decrease its losses after post harvest in addition to increase its usage in development food products . In spite of its loaded content of minerals and vitamins , it will carry on with to endure as one of food that is perishable which have a brief period of life of about 4-7 days. Adubofuor *et al*. (2016). Evaluated the banana slices quality and bread replaced with flour of ripe banana. Ripe banana slices were pre treated with citric acid for 2 mins and oven dried at 60 degree centigrade. The dried slices were milled to obtain flour. Different formulations of 0, 10, 20, and 30% of the flour of ripe banana were include into bread with flour of wheat and studied properties of sensory elements like aroma, colour, mouth feel and acceptability of overall elements of slices and bread were determined. With the exception of colour, there was no notable differentiation ($P<0.05$) around the other sensory features of dried banana were revealed. Flour of banana at 30% combination bread was most favour among the one's substitutions. It was huge ($P<0.05$) in terms of fat, ash, crude fiber, energy and moisture rather than control.

(iii) Banana chips

Making of banana to chips form may add worth to fruits and bananas wastage is reduced. Banana dried about to called as banana chips, can be eaten as a snack which gives more calories and nutrients.

Determinating the nutritional description and palatability of banana chips through baking and acceptability was studied by Abd Elmaneimelkhalifa *et al*. (2014). Value of Nutrition and accepteness of this food stuff is also evaluated acquired results shown that banana chips fried were seems better in standard and accepteness than that of chips of potato Fried. Chips of banana and fried potato are better in quality and acceptability than to baked banana chips. Banana chips have mineral nutritional value and reasonable energy supply and have high market potential. Extra minerals like potassium, phosphorous are a good source of energy was found in banana chips. Chips from banana were received by the panelists and arrived in first place of liking accompanied by control (potato chips). Chips from banana that is baked is not received satisfiedly

(iv) Banana muffin

Demand for gluten free products is increasing in the market. Banana flour can be used in bakery products. Gluten free muffins generally prepared from flour and starches having poor quality features. In respect to, this work was undertaken by Kaur *et al*. (2017) to search into application of green bananas which are starchy, high residue of indigestible composites such as non-starchy polysaccharides, resistant starch and is gluten free from green banana flour (GBF) muffins were prepared and analysed. By 100% GBF muffins were prepared. Blended ratio of GBF: Rice is 50:50 and compared with control i.e., wheat flour (100%). Muffins were rich in minerals less L* and b* prepared from GBF and had more volume and overall acceptability. Muffins prepared GBF had higher calcium, magnesium and potassium content than control and composite muffins. Muffins from 100% GBF had a favourable effect on quality of muffin and can be successfully utilized as a gluten-free product.

(v) Banana wine

Banana has unique aroma, taste, abundant nutrients. These will help to develop beverages from banana, Chen *et al*. (2020) analysed the physicochemical flavour and sensory properties of juice from banana and wines which were kept at various stages of fermentation process. Banana wine which is post fermented had low pH and more brix degree, additional content of reducing sugar, alcohol and total acid rather than principal fermentation of wine of banana. In appearance, taste, aroma and typicality post fermentation of wine of banana was higher to the primary fermentation of wine. Post fermentation of banana wine (HBW) had more flavour complications than primary fermentation of banana wine (PBW). In wines main volatile components were alcohol and esters, while those in banana juice were ketones and esters. It was anticipated to assist industrial producing of wine of banana with good quality and flavour.

(vi) Extruded products

Banana extrusion was implemented for acquiring extrudates with digestibility and functional features. Rathod *et al*. (2016) focus to evolve snacks for fasting sake by using sweet potato , vari rice and powder of unripe banana. Sensory properties and physicochemical are evaluated by utilizing response surface method. The environment temperature were diverted from 160-180℃ with 170-190 rpm screw speed at constant feed moisture of the raw material. The mix of the vari rice with sweet potato and powder of unripe banana is in the proportion of 40:40:20 at 180℃ die temperature and 170 rpm screw speed along with 16% moisture were extruded and it was most acceptable.

Conclusion

Banana is rich in dietary fibre, resistant starch and helps is in colon health. Ripe banana flour helps in better blood circulation as it holds more quantity of calcium, iron, reducing sugars and potassium and also acids in curbing the craving for nicotine, caffeine.

Banana peel is rich in vitamin B6, vitamin C, fibre, magnesium and potassium, sugars, fats, calories and cholesterol are low in banana peel. Banana has good nutritional and therapeutic value, so it may produce functional food from it. Proteins, lipids and carbohydrates are the organic content that indicates that peel of banana are good source of carbohydrates and fibres. Due to high fibre content in peels it could help to treat constipation and improve health. Extracts from peel is non-toxic to human cells; therefore as it is a natural source it can be safely utilized. Raw banana has many benefits related to health but due to its unfavourable taste its not accepted by the people as their daily diet. So by transfigure the raw banana into products it can be easily acceptable and provide a tasty nutritious food.

From unripe banana flour and flour of ripe banana added value products can be prepared like cookies and bread respectively to regulate the utilization of banana flour as functional food ingredient. The development of nutraceutical ingredients for the food industry is of current interest.

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