Tropical Fruits: A New Frontier in the Bakery Industry

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Abstract

Observation of consumer expectations regarding food quality provides the basis for any successful food, bakery, production, and marketing. Nowadays, bakery products such as cookies, cakes and bread are being consumed in many countries due to general acceptability, availability, and convenience. However, bakery products are considered to be low in nutritional value. Furthermore, replacement of wheat flour with tropical fruits flour at different levels of percentage showed positive outcome on functional and nutritional properties of bakery products. Tropical fruit products, in addition to enhancing sensory attributes of bakery products, they can also improve the nutritional quality of a variety of bakery products. Thus, composite flour addition to increase nutritional value of bakery products can produce a new product with different appearance and flavor while still allowing maximum exploitation of the fruits' nutrients. In this current review nutritional value of tropical fruits and benefits of composite flour in bakery products are briefly reviewed. Several tropical fruits, such as banana, mango, jackfruit and pumpkin are already being used in baking in composite flour i.e. wheat flour partially substituted with flour from other crops. Also, several tropical fruits with potential application in the bakery industry are briefly reviewed.

KEYWORDS: Tropical fruits, bakery, flour, nutritional value

Introduction

Recent years has seen much growth in the bakery industry in Malaysia (Sudha, Vetrimani et al. 2007). Bakery products consists of a variety of facets depending on different ingredients, and among these ingredients, dietary fibre (DF) has gained tremendous attention. There is an increasing demand for high fibre ingredients in food products (Vergara-Valencia, Granados-Pérez et al. 2007). According to (de Escalada Pla, Ponce et al. 2007)fruits and vegetables are one of the sources of DF, although the amount of DF is not as high as in cereals, but fruits and vegetables have been shown to have high amount of soluble dietary fibre which plays an important role in lowering serum cholesterol and glucose level. Insoluble dietary fibre, on the other hand, is essential in maintaining intestinal health

Composite flour is a mixture (binary or ternary) of wheat flour and flour from different source/crop (Shittu, Raji et al. 2007). Composite flour has an advantage where importation of wheat flour is concerned because it promotes the use of local crops, reduces wheat flour procurement and increases utilization of indigenous resources (Hugo, Rooney et al. 2000).

Composite flour in bakery

There are several tropical fruits already well-known on their use in the bakery industry. These fruits include: banana, mango, jackfruit, guava and pumpkin.

Banana

Belonging to the family Musaceae (order Zingiberales), bananas are grown throughout tropical and warm sub-tropical regions in areas save from strong winds with a warm temperature climate. The fruit is rich in potassium and contain small amounts of calcium, copper, iodine, iron, phosphorous, zinc and vitamins A, B, and C. Bananas are also low in sodium. An average sized banana contains approximately 90 calories, 350 milligrams of potassium, 1 gram of protein, 23 grams of carbohydrates (Simonne, Bobroff et al. 2010). On a dry weight basis, green banana pulp contains anywhere between 70% to 80% starch (Zhang, Whistler et al. 2005). It is reported that banana and tomato peels are a good source of carotenoids (Baysal, Ersus et al. 2000; Ajila, Bhat et al. 2007) .High starch content, similar to that of white potato pulp and corn grain endosperm, makes bananas ideally suited for flour processing (Waliszewski, Aparicio et al. 2003). Banana flour is a starchy food that contains high proportions of indigestible compounds such as resistant starch (RS 17.5%) and non-starch polysaccharides; part of its dietary fiber content (DF 14.5%) (Juarez-Garcia, Agama-Acevedo et al. 2006). Banana flour added to pasta and pasta products exhibit a low rate of carbohydrate enzymatic hydrolysis that could help broaden the range of low glycemic index foods available for consumers. Furthermore, antioxidant capacity of banana flour due to condensed tannins present in the banana flour makes it a more attractive source of carbohydrate (Kondo, Kittikorn et al. 2005). (Agama-Acevedo, Islas-Hernández et al. 2012) reported that when cookie flour is made up of partially fruit flour (in various levels) cookies contain higher dietary fiber and resistant starch and lower hydrolysis percentage and predicted glycemic index, rendering the cookies nutritious and aid consumers with health problems such as diabetes and obesity.

Jackfruit

Also known as jaca and breadfruit, the Jackfruit (Artocarpus integrifolia L.) is primarily grown in Asia, Central Africa, and South America. Belonging to the family Moraceae, the fruits turn brown and deteriorate quickly after ripening. Due to its intense flavor, it is commonly used in ice cream, chutney, jam, jelly, and found in paste form or canned in syrup. Ripe bulbs of the jackfruit is often dried, fried in oil, and salted like potato chips while the seeds are rich in vitamins B1 and B2 and can be dried and used as a vitamin supplements. Its peel holds constituents that can be made into peptin extract and its fruits are rich in vitamin A and minerals such as phosphorus, potassium, and calcium (Fernandes, Rodrigues et al. 2011). The ripe Jack fruits consisted 29% pulp, 12% seeds and 54% rind (Aziz 2006).The seeds are edible and nutritious and contains 38% carbohydrate, 6.6 protein and 0.4 % fat (Fernandes, Rodrigues et al. 2011). In general, fresh seeds are considered to be high in starch , low in calcium and considered as a good source of vitamin B1 and B2 (Fernandes, Rodrigues et al. 2011). High carbohydrate and other nutritional content of the seed make it a suitable ingredient in bakery products such as bread to increase fiber content (Amin 2009). Jackfruit seed in noodles increased protein content and improved overall nutritional value of the noodles. Chemical composition in noodles substituted with jackfruit seeds indicated decrease in fat and moisture content compared to control noodles. Also, ash and crude fiber contents in 30 % substitution of jackfruit seed

flour were higher than that of control noodles (Amin 2009). Supplementation of jack fruit seed flour to the wheat flour in bread increases fibers and slightly deceases protein (Aziz 2006). Development of reduced calorie chocolate cake was successful by partially replacing sucrose with polydextrose at 11 % and jackfruit seed flour at 16 % resulting in approximately 34 % calorie reduction as compared to the control cake (Amin 2009).

Pumpkin

Pumpkin (Cucurbita maxima) of the Cucurbitaceae family (Argentina) is grown in subtropical Florida and tropical countries (Azurdia 2006), a good source of carotene, pectin, mineral salts, vitamins and other constituents which are beneficial to health. Thus, leading to the processing of pumpkin into a myriad of food products (Argentina)**.** Adding pumpkin flour at different levels (5 %-15%) in composite flour showed an increase in ash and crude fiber with a decrease in fat and protein (See 2007). Previous studies substituting pumpkin powder into the noodles demonstrated an increase in beta carotene and also improvements in color and sensory characteristic (Chi-Ho Lee 2002). Substitution of pumpkin seed flour in cookies at different levels (0 %-25 %) indicated increased protein, calcium, sodium and phosphorus contents (Giami, Achinewhu et al. 2005).

Mango

Mango belongs to the genus *Mangifera* and consists of numerous species of tropical fruiting trees in the flowering plant family Anacardiaceae. *Mangifera indica* L. is the most important and widely distributed species. Currently, mango is the world's fifth important food crop (Marmot, Rose et al. 1978), mango thrives in tropical and sub-tropical countries. Asia makes up around 77 % of total mango production whilst America and Africa make up around 13 % and 9 %, respectively. Mango peel and pulp have been confirmed to have health benefits as they are rich in a variety of phytochemicals and bioactive compounds such as dietary fibre, polyphenol, carotenoid ,enzyme, vitamin C and E and others all of which provide beneficial effects for human health (Beerh, Raghuramaiah et al. 1976; Larrauri, Rupérez et al. 1996; Larrauri 1999; Ajila, Naidu et al. 2007; Vergara-Valencia, Granados-Pérez et al. 2007). These bioactive compounds have also been reported to show high values of antioxidant activity (Ajila, Leelavathi et al. 2008). Unripe mango pulp has been reported to have high starch content and high levels of hemicellulose, lignin, cellulose and carotenoids (Vergara-Valencia, Granados-Pérez et al. 2007). Mango peel has also high proportion of soluble dietary fibre (Larrauri, Rupérez et al. 1996). Substitution of mango peel and pulp in bakery products showed increase in total dietary fiber and polyphenols and antioxidant activity of the product (Vergara-Valencia, Granados-Pérez et al. 2007).

Mango peels showed that it has polyphenols and dietary fiber (Larrauri, Rupérez et al. 1996). Consumption of mango either as a whole fruit or in a processed method could be increased in the diet, thereby keeping body healthy. Mango peel, by-product of mango processing industry, could be a rich valuable components of raw and ripe peels from two Indian mango varieties (Ajila, Bhat et al. 2007).

Guava

Guava (Psidium guajava L.) belongs to the family Myrtaceae and is native to Central America, Northern South America, and parts of the Caribbean.

Depending on the variation of species guava pulp may be sweet and deep pink with midline seeds of variable number and hardness. It is rich in vitamins A and C, omega-3, -6 polyunsaturated fatty acids, and contains high levels of dietary fibre. Besides having healthy levels of the dietary minerals, potassium, magnesium, guava contains more than four times the amount of vitamin C than oranges. Commercially, guava is processed into juice, jams, marmalade, ice cream, cookies, and several bakery products. Sliced dried guava is a product widely present in commercial markets in Southeast Asia. (Fernandes, Rodrigues et al. 2011). Partial substitution of wheat flour with guava seed flour in cookies showed improvement in volume, specific volume, diameter and thickness of the cookies after baking (El-Din and Yassen 1997).

Tropical fruits with potential application in bakery

These fruits are not used in composite flour for baking but have other applications in the bakery industry such as: filling, condiments and garnish. Even if possible, literatures for the information of use of these following tropical fruits in composite flour for baking are scarce.

Star fruit

Star fruit (Averrhoa carambola L.), belongs to the family Oxalidaceae also known as carambola, is popular fruit crop found in Southeast Asia, Trinidad, Malaysia, parts of East Asia, and South America. Star fruit is native to Indonesia, India, and Sri Lanka and. It is rich in vitamin C, oxalic acid, and phosphorus and where bakery is concerned it is employed in puddings and tarts (Fernandes, Rodrigues et al. 2011). However, there is no published information on the use of star fruit in baking as part of composite flour; as far as it can be ascertained.

Langsat

Literature on Langsat (Lansium domesticum) native to India, Malaysia, Indonisa, Brneo and Philipines has freshy fruits. On its use in the bakery industry is rather scarce. However, studies have reported findings on antimalarial tetranortriterpenoids from langsat seeds (Nishizawa, Nademoto et al. 1988) (Saewan, Sutherland et al. 2006) and isolation of cycloartanoid triterpene from langsat leaves (Fernandes, Rodrigues et al. 2011). Because of higher secondary antioxidant as measured by the iron (II) chelating experiment (Lim,Lim et al., 2007), it become probably applicable to enhance bakery products.

Malay apple

Malay apple (Syzygium malaccense L.) known as mountain apple, pomarosa, and jambu belongs to the family Myrtaceae and is native to Malaysia. Although, it has been introduced throughout tropical Countries such as: Jamaica, Puerto Rico, and Trinidad and Tobago. A good source of vitamin A, Malay apple is juicy and is predominantly sold in fresh. Like langsat, no commercial use (in bakery or otherwise) of this fruit has been reported so far. (Fernandes, Rodrigues et al. 2011).

Papaya

Papaya (*carica papaya L*) belongs to the family *Caricaceae* and is grown in Australia, Hawaii, Philippines, Sri Lanka, South Africa, India, Bangladesh, Malaysia, and a number of other countries in tropical America (Anuara 2008). Papaya ranks highest per serving among fruits for

carotenoids, potassium, fiber, and ascorbic acid content (Reference 2008). Papaya contains 108 mg ascorbic acid per 100g of fresh fruit, which is higher than oranges at 67 mg/100g (Lim, Lim et al. 2007). Papaya fruit is highly appreciated world-wide for its flavor, nutritional qualities, digestive properties and serotonin (Fernandes, Rodrigues et al. 2006). Papaya is a good source of serotonin (0.99mg/100mg), which has been associated with enabling the gut to mediate reflex activity and also decreasing the risk of thrombosis (Santiago-Silva, Labanca et al. 2011). Such properties make it favorable for use in bakery products to enhance nutritional qualities. Because of good in antioxidant and soluble dietry fibre can be improved the bakery products.

Durian

Durian (Durio sp. L.) belongs to the family Malyaceae is originated from South East Asian countries such as Thailand, Brunei, Indonesia and Malaysia. Its large size, unique odor and thorn-covered husk has received the title "king of fruits'' for the fruit. It is valued and known in Southeast Asia for its taste and high amount of sugar, vitamin C, potassium, and serotoninergic amino acid tryptophan. Not only it is a good source of carbohydrates, but it also contains proteins and fats. Vacuum freeze-dried durian available in the southeast Asia region is not as popular as its fresh counterpart. Durian are sold as paste, sauce, can and syrup (Fernandes, Rodrigues et al. 2011). Due to high sugar and amino acid in durian and especial taste of the fruit can be improved the bakery products and make it new taste bakery products.

Fig

Fig (ficus carica L.), a fruit most likely originated in Western Asia and diffused to the Mediterranean, has an excessive significance in nutrition. It has high level of carbohydrate, essential amino acids, vitamins, and minerals. Fresh figs are very sensitive to microbial spoilage, even when they are stored in low temperatures. The oldest way to preserve figs are drying and crystalizing methods. Figs are used in various products such as pies, puddings, cakes, and bread (Fernandes, Rodrigues et al. 2011). Figs are very nutrient fruit that can be eaten in two forms, fresh or dried. Dried figs can be traded for various uses, such as for table consumption or for processing as paste or canned (Mars 2001). For example, the variety 'Mission' can be utilized for dried fruit, paste or juice of concentrate, while the cultivars 'Kadota' and 'Adriatic' are greatlu used for paste (Bang-Andersen, Lenz et al. 1997). Most fig production is used for the dried fig market in California (Tous and Ferguson 1996), often sold to cookie and energy bar companies (Pollack and Perez 2008) (USDA, 2004). A vast majority of fig consumers use figs as an ingredient in baked goods and pastries, as a snack and in cooked dishes (Crisosto, Bremer et al. 2010) .Dried figs can also be sold as jam. Dried figs of low quality are used as ingredients for making coffee and for juice concentrate. Thus, figs culls and leaves can be used as animal feed (Mars 2001).

Genipap

Genipap (Genipa Americana L.) is native to rainforest in northern South America, the Caribbean, and southern Mexico. Genipap is also known as jagua, chipara, guayatil, maluco, and caruto. The fruit has high phosphorus and calcium content and the tree belongs to the family Rubiaceae. The fruit is utilized mostly for producing beverage (liquor), but the fresh fruit sometimes added as a substitute for

commercial pectin to help the jellying of low pectin fruit juices (Pinto, Guedes et al. 2006). Because of high in pectin (soluble dietary fibre) and ash can be improved the texture of bakery products.

Salak

Salak (Salacca edulis) is native to Malaysia and Indonesia, a good food due to high level of dietary fibers and carbohydrate fractions (Lestari, Keil et al. 2003). Moreover, salak has valuable bioactive antioxidants such as pro-vitamin C, and phenolic compounds (Leong and Shui 2002);(Leontowicz, Leontowicz et al. 2007). However, salak has a short shelf life around 1 week, because it ripens rapidly and bioactive ingredients degrades in the fruit. Salak is sold in three forms, fresh, pickled and dried. Salak is not common for export due to short shelf life.

Anola

Anola or Indian gooseberry (Phyllanthus emblica L.) or "Ma-khaam Pom" as known in Thailand (Chatchavalchokchai 1987) is native to tropical Southeast Asian countries such as Thailand, and is known as a rich source of vitamin C. The fruit is generally consumed in both fresh and different preserved forms such as pickles, dried fruits, and beverage products (Montri 1998). Indian gooseberry tea is another product consumed as instant beverage powder or pasteurized juice. It is usually consumed for thirst quenching. Due to high in vitamin C (type of antioxidant) can be useful in bakery.

Avocado

Avocado (Persea Americana Mill.) is also known as palta, aguacate, abacate, butter pear, or alligator pear and belongs to the family Lauraceae. The tree is indigenous to Perú, Mexico, South America, and Central America. Avocado is commercially valuable crop and its trees and fruits are cultivated in tropical climates around the globe, producing a green-skinned, pear-shaped fruit that ripens after harvesting. Approximately 75% of an avocado's calories come from fat, with most of it is monounsaturated fat. It is high in vitamins A, B, and E as well as in potassium. They have the highest level of fiber content of all fruits-including 75% insoluble and 25% soluble fiber (Morton and Dowling 1987). Avocados have been used in producing ice cream, pickle , and guacamole powder, Because of high in fibre vitamin A ,B and E have a good potential in the bakery.

Ber

Ber is cultivated around the arid parts of India, Pakistan, Bangladesh, Sri Lanka, central to Southern Asia, and in the northern part of Australia. Ber fruit is richer than apple in protein, phosphorous, calcium, carotene, and vitamin C (Bakhshi and Singh 1974). In order to prepare a dehydrated product similar to dry dates, fully ripe fruits are dried. During off season the dehydrated ber is consumed and is relished as a dessert (Pareek 2001). The dehydrated ber has shown a good demand and is expected become more popular. Antioxidant properties related to the content of the fruit flesh and thus it is attracting attention from consumers, growers and researchers. (Azurdia 2006). Due to high amount of carotene and antioxidant, it can be considered as a good potential in bakery.

Dietary fiber in fruits

Dietary fiber from cereals are more frequently used that those from fruits to (Sánchez-Moreno, A Larrauri et al. 1999) (Sánchez-Moreno, A Larrauri et al. 1999); (Larrauri 1999). However,

due to higher total and soluble fibre contents, water and oil holding capacities, colonic ferment ability, lower phytic and caloric value contents, fruit fiber have better quality.

It is necessary to develop procedures for preparing fruit fibers that minimize the losses of related bioactive components (flavonoids, polyphenols, carotenes, etc.) which may exert higher health promoting influences that the dietary fiber itself.
The structure of fiber fractions in forages and cereals has been completely investigated, but in fruits and vegetables, fiber has not been well studied. Previous investigations (Marmot, Rose et al. 1978; Lund and Smoot 1982) (Lund and Smoot 1982) indicated some differences between cereal products, fruits and vegetables. Vegetables have been found somewhat low in lignin, grain products have relatively high hemicellulose concentrations, and the structure of fruits is generally somewhere in between. Although, some tropical fruits and vegetables have been analyzed, for most of the common examples, fiber content has not been reported. Tropical fruits and vegetables perhaps contain unusual fiber components, some of them have unique physiological properties, such as specific lipid binding capacities.

Conclusion

Tropical fruits have great potential in the bakery industry as composite flours, filling, condiments and garnish. Its potential, however, is under-investigated. Nutritionally, sound and beneficial bakery products are taking center stage and the use of tropical fruits is a new frontier which offers a wide array of possibilities. Naturally present nutrients and bioactive compounds offer an attractive option to enhance bakery products and shift them from mere indulgence to sheer goodness.

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