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Nutritionally enriched cake using vegetable and fruit waste: A review

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Abstract
Cake is considered as a semi-dry spongy food item that contains air pockets that have entrapped in a starch and protein network. Cake has being prepared by using different constituents like eggs, flour, sugar, fat, additives and leavening agents. The final quality of the cake is influenced by the different formulations used in cake. In today's society cake is consumed as one of the most common and popular dessert. Each ingredient in cake performs specific function and enhances the importance of cake in the market. Fruits and vegetables are also added in cake to increase the quality of the cake. Pumpkin is rich in antioxidants, proteins, vitamins, carotenoids and minerals but low in calories and fat. Pumpkin is anti-diabetic, anti-carcinogenic, anti-inflammatory, anti-microbial and anti-parasitic in nature. Along with the flavor pumpkin also enhance the nutritive value of the cake. Apple pomace is a waste generated from apple juice industry. Apple pomace is an excellent source of dietary fibre, proteins, pectin and antioxidants. Apple pomace has many health benefits. Pumpkin and apple pomace also show some medicinal properties. The cake prepared from apple pomace and pumpkin was evaluated for its proximate and physico chemical parameters.

Keywords: Cake, pumpkin, apple pomace

Introduction
One of the bakery products in industry is cake. Globally, the market has currently grown about 1.5%. Cake is a bakery product that is mostly liked by the people. The operations involve in cake making are batter formulations. The cake contain high amount of liquid phase which results in low viscosity of the batter (Cauvain and Young, 2006) [4]. Generally, the basic constituents in cake making are leavening agents, eggs, sugars, oil or fat and flour. They are moderately intense with a crumb texture and relatively sweet in taste.

Role of ingredients in cake making
During mixing of the batter, the water holding capacity of the flour particles affects the viscosity of the batter. As a result of high viscosity, there is no migration and coalescence of gas cells and fat crystals which contributes to an even batter suspension and foam. The structural binder in cake is flour that helps in the crust and crumb structure of the cake. Flour also acts as a toughener. Many characteristics have been observed by changing the ingredients in cake making. The characteristics are change of color from light to intense cake. There are three major factors that are used to determine the quality of the cake: the balanced formulations of ingredients, balanced formula and optimal baking and mixing process (Cauvain and Cyster, 1996; Cauvain and Young, 2006) [5, 4].
The most common sugar used in cake making is sucrose (Bennion and Bamford, 1997) [1]. The tenderizers in cakes are fat and sugar. They provide the soft structure and develop the flavor in cake. Sugar has a tremendous effect on fat and helps in the breakdown of crystals during mixing (Sheperd and Yoell, 1976) [21]. The sugar helps in the denaturation of egg protein and also helps in starch gelatinization (Donovan, 1977) [7]. Increased sugar level has lower gelatinization temperature of starch. The denaturation temperature of egg protein is higher as the increase in sugar level is observed (Donovan, 1977) [7]. The gelatinization of starch and denaturation of egg protein must occur at the same time for proper volume of the cake. The higher level of sugar leads to increase in the gelatinization temperature of starch which in turn collapses the cake during baking process. At the sugar level 55-60% increases the gelatinization temperature of starch from 57-92 ˚C and causes cake to collapse (Kim and Walker, 1992) [13]. The role of the eggs in cake batter is to form a membrane on the particles of fat with the help of yolk lipoprotein which can be adjustable to the fat particles having irregular shape (Shepherd and Yoell, 1976) [21].

During mixing of the ingredients, formation of gas cells takes place and they retain in the fat. It helps to stabilize the gas cells. Stabilization process is done with the help of egg white proteins, in which melting of fat crystals and also the migration of gas cell from fat to aqueous phase takes place. The foaming agent in egg white is globulin and foam stability is provided by ovomucin (Mine, 1995) [15]. The foam stability can be enhanced by the egg white interactions like ovomucin-lysozyme or ovalbumin- ovotransferrin (Weijers *et al.*, 2006) [30]. The egg yolk causes the displacement in egg white protein so therefore egg yolk is considered harmful to the foam properties and further it leads to the decrement in the elasticity (Kiosseoglou and Paraskevopoulou, 2006) [14]. Eggs are emulsifying, drying and leavening agents of the batter ingredients. During mixing, foam and emulsion from egg proteins result in airy structure of the cake and it leads to foam formation where the air cells are incorporated into the batter. The more is the size of air pockets, higher will be the volume. A high quality cake is determined by its volume and moist crumb (Sahi and Alava, 2003; Cauvain and young, 2006) [20, 4].

The characteristic texture that occurs in cake is due to chemical leaveners. The main function of leaveners is to produce gas. The resultant gas is produced due to the mixing of carbon dioxide (CO_2) source and acid when they come in contact with water. The gas leads to the formation of bubbles that are entrapped inside the dough or batter and allow the product to expand. Baking soda, a leavening agent is one the important source of carbon dioxide (Pop, 2007) [17].

The creamy texture is achieved by mixing of fat and sugar together (Shepherd and Yoell, 1976) [21]. The type of crystal and solid fat index affects the fat creaming property. The fat exists in 3 different forms: α, β, β'. The least stable form of fat is α-form and also has lower melting point as compare to other forms whereas the stable form of fat is β-form which also has high melting point among all (Ghotra *et al.*, 2002) [11]. The small crystals are considered best for stabililization of gas cells. In bakery industry, fat improve moistness, mouth feel and tenderness. Generally, fat with higher percentage is responsible for more tender cakes (Bennion and Bamford, 1997) [1]. The crumb softness of the cake is determined by fat dispersion (Shepherd and Yoell, 1976) [21].

Pumpkin

The botanical name of pumpkin *Cucurbita maxima*. Pumpkin is an essential vegetable cultivated globally (Taylor and Brant, 2002) [24]. Pumpkin is a source of β-carotene, α-tocopherol, Vitamin C, Vitamin A, carbohydrates, amino acids, flavonoids and phenols thus considered as a functional vegetable (Wang *et al.*, 2002: Wang and Zhao., 1998: Zhang *et al.*, 2000: Zhang *et al.*, 2002) [29, 28, 33]. The risks of diseases are far away by the intake of food rich in antioxidant and promote healthy life (Temple, 2000: Willet, 1994) [25, 31]. Pumpkin is also known as kashiphal. Due to its high nutritive value, high productivity, good transport qualities and high storability it occupies a prominent place among all the vegetables. The color depends upon the species and varies from white, green, yellow, red and orange. The pumpkin can be consumed in variety of ways like cooked vegetable and also as frozen or canned food product (Figueredo *et al.*, 2000) [10]. Pumpkin is a rich source of β-carotene. The carotenoids are responsible for its orange-yellow color. In most of the developing country, the primary source of Vitamin A is carotenoids (Boileau *et al.*, 1999) [3]. Carotenoids that are extracted from isoprene are the coloring pigments of animal and plant tissues that permits leaves, flowers, and fruits a color which vary from yellow to red (Oliver and Palou, 2007). To increase the shelf life of pumpkin it can be processed into flour and the pumpkin flour can be used in cookies, cakes, sauces, soups, coloring agent and spice (Ptitchkina *et al.*, 1998) [19]. The physicochemical composition of fresh pumpkin and pumpkin powder is shown in table 1.

Table 1: Physico-chemical composition of fresh pumpkin and pumpkin powder.

Parameters	Fresh pumpkin	Pumpkin powder
Moisture Content (%)	87.30	6.01
Protein (%)	1.30	3.73
Fat (%)	1.43	1.32
Crude fibre (%)	1.16	2.91
Carbohydrate (%)	10.50	78.73
β-carotene (mg/100g)	2.44	7.30
Ash (%)	1.25	7.23

Pumpkin Cake

The cakes were prepared with the blends of pumpkin at different rates. It was observed that there is increase in the moisture, ash, fibre and β-carotene content of the cake but the carbohydrate, protein and fat content decreases. The protein content was high for wheat flour (14.27%) as compare to pumpkin flour (9.65%). As the cake was kept for longer period, an increase in the moisture and carbohydrate was analyze whereas the decrement was observed in ash, β-carotene, fibre and protein content of the cake. The hygroscopic nature of pumpkin leads to an increase in its moisture content (Eke *et al.*, 2009) [8]. Hydrolysis of peptide bond by the enzyme protease leads to the destruction of protein molecule and thus reduces the protein content in the cake. Similar result was seen in the cookies (Waheed *et al.*, 2010; Pasha *et al.*, 2002) [27, 16]. The percentage of dietary fibre was high in pumpkin flour including lignin, hemicellulose and cellulose which in turn results in high crude fibre (Ptitchkina *et al.*, 1998) [19]. The denaturation of hemicellulose and other polysaccharides results in low fibre content in cake. Similar results were seen in pearl millet cake (Singh *et al.*, 2006) [22]. The decrement in the fat content is due to the binding effect of fibre on fat (Eke *et al.*, 2009) [8]. The higher ash content in pumpkin powder results in higher ash content in the cake. Oxidation leads to decrease in β-carotene content. Carotenoids are sensitive to oxidation results in color loss (Potter, 1987) [18]. Thus using pumpkin powder in bakery industry is a good option to enhance the nutritive value of the products (Bhat and Bhat, 2013) [2].

Apple pomace

Apple pomace is an abundantly available by-product generated throughout the manufacturing of apple juice. It can be safely used in human food (Chauhan and Masoodi, 2007 and Verma *et al.*, 2010) [6, 26] and animal feed (Bhat *et al.*, 2000 and Teli 1982). The apple pomace, a composite mixture comprising of core, peel, soft tissue and seeds (Grigelmo and Martin, 1999) [12]. The peel of an apple is a chief source of ursolic acid. Ursolic acid is one of the most important compounds in the obesity fighting capability of apples. Consumption of ursolic acid enhances muscle and brown fat, which helps in burning the calories, thus minimizing the risk of obesity in humans. Apple pomace is produced in large amounts globally, and is highly biodegradable in nature. In Brazil, around 800,000 tons of apple pomace is manufactured per year (Protas and Valdebenito, 2003). During food

processing, apple pomace, is the vital waste product accumulated. Many chemicals that have been obtained from apple pomace are chlorogenic acid, phloridzin, procyanidins, catechin, epicatechin and the quercetin conjugates. In apple flesh, catechin, epicatechin, procyanidins, phloridzin, are present but there concentration is lower as compare to the peels. In the apple peels the quercetin conjugates are exclusively found (Escarpa and Gonzalez, 1998) [9]. As compared to flesh, the apple peels are loaded with plentiful amount of antioxidants. Apple peels have the ability to be used as a value added constituents in food products (Wolfe and Liu, 2003) [32]. The proximate analysis of apple pomace is shown in table 2.

Table 2: Proximate composition of apple pomace

Parameters	(%)
Moisture	10.80
Ash	0.50
Fat	2.70
Protein	2.06
Total dietary fibre	51.10
Insoluble fibre	36.50
Soluble fibre	14.60

Apple pomace cake

The cake prepared with 25 and 0% blends of apple pomace. The cake made from 25% and 0% of pomace has moisture content, protein content and fat content value ranges from 20.9-21.8%, 8.5-8.46% and 19.3-20.5% respectively. The total dietary fibre (TDF) content was 14.2% for the cake at the same time as it was 0.47% for control sample. Likewise, the soluble dietary fibre (SDF) content for cakes prepared from 25% and 0% apple pomace blend was 5.8% and 0.16% respectively. The above readings indicate that apple pomace could be a relatively good quality source of dietary fibre in cakes. Apple pomace being a rich source of fibre tends to increase the water absorption capacity of the flour. Its high total dietary fibre (TDF) content makes it a valuable source of dietary fibre in cake making. Apple pomace also has the potential for use as a good source of polyphenols which have antioxidant properties (Sudha *et al.*, 2007) [23]. The extracts of apple pomace contain 31% to 51% polyphenols, high in flavonols, dihydrochalcones and cinnamate esters (Will *et al*., 2006). The nutritional parameters are given in table 3.

Table 3: Nutritional facts of cake.

Nutritional Parameters	Blend (0%)	Blend (25%)
Moisture (%)	20.9	21.8
Fat (%)	19.3	20.5
Protein (%)	8.5	8.46
Total dietary fibre (%)	0.47	14.20
Insoluble fibre (%)	0.31	8.40
Soluble fibre (%)	0.16	5.80

Conclusion

The main aim was to produce a healthy and nutritive cake. The widely consumed bakery product, cake when made using a diverse group of plant foods would prove to be an excellent food item for today's fast paced society. Cake, which is commonly consumed and loved by all the people of different age groups, can also, be made healthy and nutritive by addition of apple pomace and pumpkin. The attributes that are used to explain the quality of the cake can be enhanced by adequate ingredients and correct formulations. Overall the cake made proves to be a nutrient rich functional food and thus has high possibility of use in the market.

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