Effect of natural sugar substitutes – mesquite (*Prosopis alba*) flour and coconut (*Cocos nucifera* L.) sugar on the quality properties of sponge cakes

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Abstract

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Introduction. The aim of the research was to evaluate the physico-chemical and microbiological characteristics of sponge cakes with natural sugar substitutes – mesquite (*Prosopis alba*) flour and coconut (*Cocos nucifera* L.) sugar.

Materials and methods. The sponge cake was prepared from wheat flour, sugar, eggs with the addition of Coconut sugar and mesquite flour in ratio 3:1 as natural sugar substitutes. The sponge cakes with 100% sugar substitutes were processed at constant regime of baking concurrent with that of the control sample.

Results and discussion. Specific volume of cakes varied between 2.92 ± 0.10 cm³/g and 3.13 ± 0.11 cm³/g. In this studying the volume of the cake with sugar substitutes was smaller than this of cake control (219.00 ± 2.07 cm³). The greatest porosity was observed in the cake control ($63.23 \pm 1.30\%$). The water-absorbing capacity of the cake with coconut sugar and mesquite flour ($315.60 \pm 3.08\%$) is the lowest than that of the cakes cake control. Baking losses of all the samples were in the range of 15.27–17.55%. Sugar substituted cakes had less baking loss and was statistically different from control. Cake crust of control sample had the highest values of L* (58.46 ± 2.25), a* (9.56 ± 0.62) and b* (25.31 ± 0.82). The crumb and crust color of cake with coconut sugar and mesquite flour mix was brownish and darker than cake control crumb and crust. The highest fat content was defined in the sample control (6.89%) and the lowest content was in the cake with coconut sugar and mesquite flour (5.66%). The highest percentage of carbohydrate was determined in the control (58.21%), as with the lowest content was the cake with coconut sugar and mesquite flour (23.50%). It is important to note that sponge cake with natural sugar substitutes could be tagged as foods and could support the claim “with high content of dietary fiber”. The energy value of the cake with coconut sugar and mesquite flour being the lowest – 209.98 kcal/100g of product, with 37% lower than the control cake. From microbiological point of view results of to the first day of storage at room temperature, no evidence of pathogenic bacteria and mold was detected on the samples.

Conclusions. The sponge cake made with composite coconut sugar and mesquite flour exhibited fairly good technological characteristics. From a functional and nutritional point of view, these cakes contained significantly higher levels of dietary fiber than the traditional bakery products prepared with sugar.

Introduction

Sugar reduction or removal in confectionary products is an important research objective for the food industry, considering negative press, consumer awareness around civilisation diseases and government strategies for sugar reduction in high sugar products [1].

Some studies with different *Prosopis* species indicated that it is a good source of carbohydrates, lipids, minerals, and phytochemical compounds with beneficial effects on health [2].

Mesquite flour was previously tested in simple bread formulations. MF addition in non-sweet breads modified their sensory characteristics and technological quality (specific volume, crumb texture and porosity). However, the fiber content was significantly increased by MF addition allowing obtaining fiber enriched breads [3–4]. Taking into account the particular color and flavor conferred by mesquite flour, it was considered that these characteristics would make it a good ingredient for sweet bread/cake formulations. Sweet bakery comprises a large number of products due to the great variety of ingredients that can be used in it. Mesquite flour is the product obtained by grinding the whole pods. Besides fibre, it also has proteins, lipids and provides calcium and iron, among other minerals. The level of protein is variable (7-11 g/100g) [4–5]. It is not found the scientific evidence about application of mesquite flour as sugar substitute in the cakes and influence on quality parameters.

Leguminous flours can provide both nutritional and functional benefits when added to a bakery product formula. They are usually a good source of dietary fibre and leguminous proteins are complementary to cereal proteins. When combined in composite dough, a protein mixture with higher nutritional value is obtained [6–7]. Prokopiuk et al., 2000 [5] reported 27 g/100g of total dietary fibre in *Prosopis alba* pulp. Mesquite flour is the product obtained by grinding the whole pods. Besides fibre, it also has proteins, lipids and provides calcium and iron, among other minerals. The level of protein is variable (7-11 g/100g) [4–5]. Several authors [7–9] found that the replacement of wheat flour with different amounts of leguminous flours or protein isolates obtained from them (chickpea flour, soy flour, mesquite flour) affected the rheological properties of dough due to network weakening and consequently, the quality of the final product such as volume, internal structure and texture of the breads [10]. Bigne et al., 2016, 2018 [3–4] reported that the high level of fibre in mesquite flour led to changes in the textural properties of dough, as a consequence of an inferior development of the gluten network. Higher levels of added mesquite flour led to dough with increased consistency and less cohesiveness, where a disruption of the gluten matrix was observed. However, there are unexplored legumes that have the potential for inclusion in the food industry, such as some species of *Prosopis* pods. Until now, there are a few studies on the flour obtained from these pods, and the impact of its inclusion in the bakery. In this section will be discussed the information about the pods, the obtained flour, and the bakery products with this ingredient.

Prosopis flour (PF) is described as brown and sweet with hints of coffee, cocoa, coconut, caramel or molasses, cinnamon, and hazelnut [2]; and has approximately equal energy and proteins content comparing with wheat flour, besides it is gluten-free [11]. PF production varies according to the pod and seed characteristics. Bigne, Puppo & Ferrero, 2016 [4] mentioned that PF is obtained by grinding the whole pods. Despite the full range of food that can be prepared from PP and PF, the inclusion of PF in bakery products is of particular interest among other legumes.

Coconut (*Cocos nucifera* L.) palm is a monocotyledon belonging to *Arecaceae* or *Palmae* family. Coconut palm can be processed into coconut water, coconut milk, coconut

sugar, coconut oil, and coconut meat. Coconut has a glycemic lowering effect. Low glycemic index food particularly such containing high dietary-fiber, has been demonstrated to moderate post-prandial blood glucose and insulin responses enhancing blood-glucose and lipid concentrations in humans and patients having diabetes mellitus [12].

Coconut (*Cocos nucifera*) contains higher amounts of dietary fiber (60 g/100 g) and other nutrients [12]. Coconut contains low amount of digestible carbohydrates, and has no gluten. Nutritional composition of coconut flour is quite comparable to that of wheat flour. There is an apparent need to convert the food processing byproducts into functional ingredients in order to implement their environment-friendly and efficient utilisation.

Coconut sugar is made by heating of inflorescence sap until it turns to brown and granulate, it has been a growing interest in Europe and North America as a natural sugar alternative because it has low glycemic index around 35. Coconut sugar usually uses as an ingredient in many foods and drinks to provide a pleasant flavor. Coconut flour and sugar was successfully incorporated into bakery, extruded products and traditional sweets [13–14].

The above-presented brief review on available data clearly identifies the lack of sufficient scientific evidence about the effects of these sugar substitutes on the physico-chemical and microbiological characteristics of sponge cakes. It is not determined the scientific evidence about application of mesquite flour as sugar substitute in the cakes.

The aim of the research was to evaluate the physico-chemical and microbiological characteristics of sponge cakes with natural sugar substitutes – mesquite (*Prosopis alba*) flour and coconut (*Cocos nucifera* L.) sugar.

Materials and methods

Preparation of sponge cakes

The control cake was prepared, following a traditional technology and formulation [15]. The batter formulation of the control cake was as follows (based on batter weight): egg yolk 13.35%, egg white 29.88%, refined granulated sugar 25.90%, and wheat flour 30.88%. In particular, a double mixing procedure was applied by partitioning whipping of whites and egg yolks. Coconut sugar and mesquite flour were added in cake batter in ratio 3:1 as natural sugar substitutes.

Sugar is the main ingredient of the control cake formulation (about 26% of the batter ingredients). For the modified samples, the sugar substitutes mix from coconut sugar and mesquite flour was added to replace sugar (100% replacement). The recipe compositions of the control sample and the investigated cakes containing sugar substitutes mix are presented in Table 1.

The stages of technology were kept because of their easy fulfillment and the considerably small duration of the technological cycle. The sponge cakes with 100% sugar substitutes were processed at constant regime of baking concurrent with that of the control sample, which according to the technological instruction was baked for 30 min at 180 °C (Figure 1).

Each sponge cake batter of 75 g was poured out into metallic forms and baked in an electric oven at 180°C for 30 min. The sponge cakes were stored at standard conditions (at temperature of 18°C and 75 % relative humidity). The humidity and the temperature were kept constant by means of a desiccator supplied with a psychrometer, and put in a thermostat with an accuracy of $\pm 0.5^{\circ}\text{C}$.

Table 1

Sponge cake batters formulations

Ingredients	Amount based on batter weight:	
	Control sample	With 100% sugar substitutes
Yolk of egg, [%]	13.35	13.35
White of egg, [%]	29.88	29.88
Granulated sugar, [%]	25.90	-
Wheat flour, [%]	30.88	27.89
Coconut sugar, [%]	-	19.92
Mesquite flour, [%]	-	5.98
Coconut flour, [%]	-	2.99

Figure 1. Technological scheme production of sponge cake with sugar substitutes

Physical characteristics of the batters and sponge cakes

The specific gravity of the sponge cake batter was calculated by dividing the weight of a standard batter cup to the weight of an equal volume of distilled water at batter temperature ($20.0 \pm 0.5^\circ\text{C}$) [16]. The physical characteristics of the sponge cakes were determined 2h after baking. Volume was measured by the small uniform seed displacement method [17], and porosity was assessed according to Baeva, *et al.*, 2012 [18]. The porosity of the sponge cake was defined as the ratio of the volume of air-pockets in the cake crumb to the volume of the crumb. Porosity determination was made using a cylinder driller, a device of Zhuravljov. The specific volume was expressed as the ratio of the sponge cake volume to its mass. The water-absorbing capacity of the sponge cake was measured by the extent of biscuit swelling according Baeva, *et al.*, 2012 [18]. The density was expressed as the ratio of the sponge cake mass to its volume according to Ho *et al.*, 2013 [19].

Baking loss of was calculated by following formula after measuring batter mass (BM) and cake mass (CM) according to Hathorn *et al.*, 2008 [20]:

$$\text{Baking loss} = \frac{\text{BM} - \text{CM}}{\text{CM}} \cdot 100$$

where: BM - batter mass; CM - cake mass.

Measurement of color of sponge cakes

The instrumental measurement of the cakes color was carried out with a colorimeter and the results were expressed in accordance with the CIELAB system. Color was measured at four predetermined places of the sponge cakes crust and crumb. The parameters determined were L^* ($L^* = 0$ [black] and $L^* = 100$ [white]), a^* ($-a^* = \text{greenness}$ and $+a^* = \text{redness}$), b^* ($-b^* = \text{blueness}$ and $+b^* = \text{yellowness}$). Colorimeters give measurements that can be correlated with human eye-brain perception, and give tristimulus (L^* , a^* and b^*) values directly.

The total color difference (ΔE^*) between the control cake and the sponge cakes with functional ingredients was calculated as follows:

$$\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2},$$

as: $\Delta L^* = L_1 - L_0$; $\Delta a^* = a_1 - a_0$; $\Delta b^* = b_1 - b_0$.

where: "0" – control cake; "1" – cake with mesquite.

The values used to determine if the total color difference was visually obvious were the following.

$\Delta E^* < 1$ color differences are not obvious for the human eye;

$1 < \Delta E^* < 3$ color differences are not appreciative by the human eye;

$\Delta E^* > 3$ color differences are obvious for the human eye [21, 22].

Chemical composition and energy values

The total moisture content in the cake (2 h after baking) was determined using the AACC method 44–15.02 [23] after drying out in an oven at 105°C to constant weight. The measurements were done in triplicate and the mean values were presented. The total, soluble and insoluble dietary fibre content was determined by ISO 5498:1999, using the total dietary

fibre assay kit TDF 100A (Sigma-Aldrich) and the instructions provided by the manufacturer. Protein was determined by the Kjeldahl method by ISO 20483:2013. A multiplication factor of 6.25 was used for the calculation of protein content. The total carbohydrate content was estimated according to the spectrophotometric method of Dubois et al. (1956). In brief, 0.1 ml of each extract was mixed with 1 ml of 5% phenol and 5 ml of sulphuric acid. The samples were then placed in a water bath at 30 °C for 20 minutes. The absorbance was measured at 490 nm against a blank that was prepared using the same process as that used for distilled H₂O. The fat content of the cakes was determined according to ISO 11085:2015. The energy values were obtained by the Atwater and Bryant method, using the conversion factors of 4, 9, 4 and 2 kcal/g for protein, fat, carbohydrate and dietary fiber, respectively [25]. Nutritional value of 100 g was determined according to Regulation (EU) № 1169/2011 of the European Parliament and of the Council.

Microbiological analysis

The microbiological analyses were carried out according to the Bulgarian State Standard. Analyses for total plate count (TPC) (ISO 4833-1: 2013), molds and yeasts (ISO 21527-2: 2011), coliforms (ISO 4831: 2006), *Salmonella* species (ISO 6579-1:2017) and coagulase-positive staphylococci (ISO 6888-1: 2000) were also conducted. Total plate count (TPC) in 1 g of sponge sample; the total number of molds and yeasts in 1 g of sponge sample; coliforms in 1 g of sponge sample; *Salmonella* species in 25 g of sponge sample and coagulase-positive staphylococci in 1 g of product were determined.

Statistical analysis

All experiments were performed in triplicate. The data were analyzed and presented as mean values±standard deviation. Statistical analysis was conducted using the Statgraphics Centurion XVI Version 16.2.04 software (Statpoint Technologies Inc., USA). The analysis of variance technique, incl. Lavene's test (ANOVA) and Multiple Range Test were used to determine significant differences at 95 % confidence level ($p < 0.05$).

Results and discussion

Physical characteristics of the sponge batters and cakes

The addition of coconut sugar and mesquite flour mix in sponge cakes improves their physical characteristics (Table 2). Specific gravity in cake batter provides an indication of the total air holding capacity of the batter. Low specific gravity values indicate good incorporation of air, yielding a higher final volume after baking; however, many other factors also affect this quality parameter. The difference in respect the specific volume between the control cake-sample and the sponge cakes with sugar substitutes is minimal. Specific volume of cakes varied between 2.92 ± 0.10 cm³/g and 3.13 ± 0.11 cm³/g. According to Herranz et al., 2016 [26] all chickpea flour-based muffins had significantly lower specific volume than the control. Volume of cake indicated the ability of batter to expand and incorporate gas during the baking process. In this studying the volume of the cake with sugar substitutes was smaller than this of cake control (219.00 ± 2.07 cm³). The greatest porosity was observed in the cake control ($63.23 \pm 1.30\%$). The water-absorbing capacity of the cake with coconut sugar and mesquite flour ($315.60 \pm 3.08\%$) is the lowest than that of the cakes cake control.

Table 2

Physical characteristics of the sponge batters and cakes

Physical characteristics ^a	Sponge cake types	
	Control sample	With 100% sugar substitutes
Specific gravity (for batter) ^b	0.71±0.02 ^c	0.70±0.02 ^c
Volume, cm ³	235.00±2.02 ^c	219.00±2.07 ^d
Specific volume, cm ³ /g	3.13±0.11 ^c	2.92±0.10 ^c
Porosity, %	63.23±1.30 ^c	61.05±1.20 ^c
Water-absorbing capacity, %	319.68±3.12 ^d	315.60±3.08 ^d
Density, g/cm ³	0.32±0.11 ^c	0.34±0.10 ^c
Baking loss, %	17.55±0.69 ^c	15.27±0.53 ^d

^a The values are mean±SD (p < 0.05).

^b The temperature of the batter is on the average 20.7±0.5 °C.

^{c-d} The values in a line with identical letters do not differ statistically significantly (p < 0.05).

Cake density, which is defined as weight of unit cake volume (g/cm³), increased by adding coconut sugar and mesquite flour mix. There were no differences between density of control cakes and sugar substituted cakes, likewise porosity and specific gravity values of cakes (p>0.05).

Gas formation during baking caused an increase in vapor pressure, which was likely due to the expansion of liquids when heat was applied to the batter. The loss of gas during baking is called 'baking loss' [27]. Baking losses of all the samples were in the range of 15.27–17.55%. Sugar substituted cakes had less baking loss and were statistically different from control. Mohamed et al., 2012 [8] reported that green banana flour components which had high water binding capacity, especially insoluble fibers (lignin, cellulose, hemicellulose), could cause water intake from other ingredients in product formulation. They also reported [28] that high percentage substitution of green banana flour leads to high water intake from other ingredients in product formulation, and it affects quality characteristics of dough and final product such as volume, hardness and colour negatively. In other study, decrease of baking loss with increasing GBPF substitution level may be attributed to high water absorbing capacity (4.91-5.88 g water/ g dry matter) reported by Alkarkhi et al., 2011 [28] which is a functional characteristic of green banana flour.

Color characteristics

The effects of sugar substitutes addition on the color characteristics of sponge cakes are presented in Figure 2 and Figure 3. The results were expressed by L*, a* and b* values corresponding to lightness, redness, and yellowness, respectively. Significant differences of the crust and crumb colors were observed between the control cake and the cake substituted with sugar substitutes (P<0.05).

Crust color of cakes. The brownish color of crumb in composite breads is not due to the development of Maillard products, but probably to enzymatic reaction products since in the stages of dough preparation the darkening of the dough with the presence of mesquite flour was already observed [29]. In this way, during dough preparation in the presence of water, browning enzymatic reactions may occur. The lightest samples (highest L* values) were control cake (58.49±1.23) present in Figure 2. The control has the highest values of a* and

b* indicating a significantly brighter and more saturated yellow color. The lightness, a* and b* values for control were significantly different from those of the cake with sugar substitutes. According to these results, cakes with sugar substitutes – coconut sugar and mesquite flour where the ΔE^* was appreciable by the human eye ($\Delta E^* > 3$).

Figure 2. Crust color values of sponge cakes

Cake crust of control sample had the highest values of L* (58.46 ± 2.25), a* (9.56 ± 0.62) and b* (25.31 ± 0.82). The brownish color of crust is mainly due to the development of products of non-enzymatic browning reaction (Maillard), favored by the loss of moisture and high temperatures during baking in the presence of sugars and proteins.

Crumb color of cakes. The variations in the crumb color of the cakes with sugar substitutes as sugar replacer were similar to the variations in crust color (Figure 3). The crumb of cake with coconut sugar and mesquite flour mix was brownish and darker than cake control crumb. The cake control was the lightest and the b* values showed that this sample had a brighter color. According to these results, the cake with sugar substitutes where the ΔE^* was appreciable by the human eye.

The brownish color of crumb in composite breads is not due to the development of Maillard products, but probably to enzymatic reaction products since in the stages of dough preparation the darkening of the dough with the presence of MF was already observed. The polyphenol content of MF was previously reported by several authors [30-31] and even though there are no recent reports of polyphenol oxidase activity in mesquite, the presence of this enzymatic activity in many legumes is well known [32]. In this way, during dough preparation in the presence of water, browning enzymatic reactions may occur.

Generally, crumb color of the cakes is affected by the ingredient used and its formulation [33].

The brownish color of crumb in composite breads is not due to the development of Maillard products, but probably to enzymatic reaction products since in the stages of dough preparation the darkening of the batter with the presence of mesquite flour was already observed.

Figure 3. Crumb color values of sponge cakes

The difference in chemical composition of sugar and coconut sugar and mesquite flour mix might provide different colors of the new cake.

Chemical composition and energy value of sponge cakes

The results of chemical composition and energy value of sponge cakes with functional ingredients are presented in Table 3.

Table 3

Chemical composition and energy value of sponge cakes (100 g product)

Basic chemical composition and energy value	Type of sponge cakes	
	Control	With 100% sugar substitutes
Total moisture, [%]	28.55 ±0.04 ^b	30.00±0.01 ^c
Protein, [%]	14.09±0.10 ^b	21.01±0.16 ^c
Fat, [%]	6.89±0.03 ^b	5.66±0.32 ^b
Carbohydrate ^a , [%]	58.21±0.31 ^b	23.50±0.20 ^c
Total dietary fibre, [%]	2.21±0.28 ^b	9.50±0.21 ^c
– Insoluble dietary fibre, [%]	1.61±0.07 ^b	6.77±0.08 ^c
– Soluble dietary fibre, [%]	0.60±0.03 ^b	2.73±0.09 ^c
Energy value, [kJ/100 g]	1449.58	878.58
[kcal/100 g]	346.79	209.98

^a “Carbohydrate” any carbohydrate which is metabolized by the human body with the exception of dietary fibre according Regulation (EU) № 1169/2011.

^{b-c} The values in a line with identical letters do not differ statistically significantly ($p < 0.05$).

The cake with 100% sugar substitutes was with the highest level of moisture (30.00%), and the control cake was with the lowest moisture content (28.55%). The sample with 100% sugar substitutes (21.01%) was characterized with the highest protein content, while the lowest protein content was found in the cake control (14.09%).

The highest fat content was defined in the sample control (6.89%) and the lowest content was in the cake with coconut sugar and mesquite flour (5.66%). The highest percentage of carbohydrate was determined in the control (58.21%), as with the lowest content was the cake with coconut sugar and mesquite flour (23.50%). According to the obtained results the carbohydrate content decreased with the addition of the natural sugar substitutes. The results indicated that there was a significant increase in the total dietary fibre content in sponge cakes incorporated with natural sugar substitutes. The highest amount of total dietary fibre had cake with 100% sugar substitutes (9.50%), while it was 2.21% for control cake. By forming viscous solution, soluble fibre slows intestinal transit, delays gastric emptying, and reduces glucose and sterol absorption by the intestine. It is important to note that sponge cake with natural sugar substitutes could be tagged as foods and could support the claim “with high content of dietary fiber”, according to the provisions of FAO/WHO guidelines (Codex Alimentarius Commission & FAO, 2009) [34] because they exceed the 6 g of TDF per 100 g of product. The energy value of sponge cakes control is 346.79 kcal/100g of product, as the cake with coconut sugar and mesquite flour being the lowest – 209.98 kcal/100g of product, with 37% lower than the control cake. Bigne et al., 2018 [3] reported that the high level of fibre in mesquite flour led to changes in the textural properties of dough, as a consequence of an inferior development of the gluten network. Higher levels of added mesquite flour led to dough with increased consistency and less cohesiveness, where a disruption of the gluten matrix was observed.

The most relevant nutritional aspect is related to the fibre content of cake. With only 30% replacement of sugar by mesquite flour, total dietary fibre content increased more than twice, reaching a value of 9.50 g/100g.

Microbiological analyses

Microbiological spoilage is often the major factors limiting the shelf life of bakery products. Spoilage from microbial growth causes economic loss for both manufacturers and consumer. These losses could be due to many individual cases such as, packaging, sanitary practice in manufacturing, storage conditions and product turnover. Yeast problems occur in bakery products. Contamination of products by osmophilic yeasts normally results from unclean utensils and equipment. Therefore, maintaining good manufacturing practices will minimize the contamination by osmophilic yeasts. According to Malkki & Rauha [35] mold growth on bakery products is a serious problem that results in economic losses. Furthermore, losses of products due to mold spoilage are between 1 and 5 per cent depending on the type of product, season, and the method of processing. Mold spores are generally killed by the baking process in fresh bread and other baked products [36]. Therefore, for bread to become moldy, it must be contaminated either from the air, bakery surfaces, equipment, food handlers or raw ingredients after baking during the cooling, slicing or wrapping operations. This means that all spoilage problems caused by molds must occur after baking [37]. The mold spore counts are higher in the summer months than in the winter due to airborne contamination in the warmer weather and more humid storage conditions. Furthermore, moisture condensation on a product's surface, due to packaging prior to being completely cooled, may be conducive to mold growth [38].

The results of total plate count (TPC) and yeast and mould count of sponge cakes are presented in Table 4. No pathogenic bacteria such as coagulase-positive staphylococci in 1 g of the samples *Salmonella* spp. in 25 g of the samples and fecal coliforms in 1 g of the samples, respectively, were not detected.

Table 4

Microbiological characteristics of the sponge cakes

Microbiological characteristics	Control	With 100% sugar substitutes
Coliforms, [CfU/g] ¹	ND ²	ND
<i>Salmonella</i> spp.in 25 g	ND	ND
Coagulase-positive staphylococci, [CfU/g]	ND	ND
Total plate count, [CfU/g]	0	0
Molds and yeast, [CfU/g]	0	0

¹ CfU/g – Colony forming Units per gram

² ND = Not detected

Up to the first day of storage at room temperature, no evidence of mold was detected on the samples.

The study of Soltandela et al., 2010 showed that contamination of fresh dough to molds, yeasts, Enterobacteriaceae, Bacillus and Staphylococcus differ from 50 to 83%, respectively [39].

According research of some authors [41–42] cross contamination is one of the reasons for contamination of cakes by molds. Most of the contaminated factors are destroyed in process because of high temperature of cooking process, so Probably one of the reasons being cake samples free from contamination or in accepted levels in our factory were the worker's personal hygiene. In addition to the importance of personal hygiene, additional activities to promote health and quality level of these products and improve them to global standards and excellent sanitary process must be done.

Conclusion

1. The flour obtained from the pods of *Prosopis alba* (mesquite flour) demonstrated to be a versatile ingredient to be incorporated in “cake” formulations. The sponge cake made with composite coconut sugar and mesquite flour exhibited fairly good technological characteristics.
2. A remarkable aspect is that from a functional and nutritional point of view, these cakes contained significantly higher levels of dietary fiber than the traditional bakery products prepared with sugar.
3. The results confirm the adaptability of mesquite flour to be incorporated in different cakes formulations rendering healthier distinctive products.

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