

Effect of tragacanth gum on texture and staling of commercial sponge cake

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ABSTRACT

Background & Aim: Tragacanth is a natural gum obtained from the dried sap of several species of Middle Eastern legumes of the genus *Astragalus*, that is a viscous, odorless, tasteless, water-soluble mixture of polysaccharides. Tragacanth is used in pharmaceutical and foods industries as an emulsifier, thickener, stabilizer, and texturant additive. Sponge cake is one of the most popular bakery products due to its nutritional value, ready-to-eat nature, long-shelf life and specifically its fine structure. Tragacanth gum can improve textural properties of bakery products due to its nature as a hydrocolloid.

Experimental: In this study, texture profile analysis (TPA) and also cutting tests (for crumb and crust) were applied to find out the effects of tragacanth gum on the textural properties of commercial sponge cakes during 30 days. The concentrations of tragacanth gum were 0.1, 0.2, 0.3, 0.4, 0.6, and 0.8% (w/w) in the cakes' batter.

Results & Discussion: Results revealed that tragacanth gum up to 0.4% led to softening the texture of the cake and reducing the signs of aging.

Recommended applications/industries: Application of tragacanth gum (up to indicated level) in bakery products, particularly the sponge cake, can improve textural properties and increase shelf life of these products.

1. Introduction

Hydrocolloids are native water-soluble polymers. They can control textural and sensorial properties of food due to influencing on rheological characteristics (McKenna, 2003). Tragacanth gum is a hydrocolloid which was used in this study. Tragacanth is a natural gum obtained from the dried sap of several species of Middle Eastern legumes of the genus *Astragalus* (the family Fabaceae). Iran is the biggest producer of the

best quality of this gum. Tragacanth contains from 20% to 30% of a water-soluble fraction called tragacanthin (composed of tragacanthic acid and arabinogalactan). It also contains from 60 to 70% of a water-insoluble fraction called bassorin. Tragacanthic acid composed of D-galacturonic acid, D-xylose, L-fructose, D-galactose, and other sugars. Tragacanthin is composed of uronic acid and arabinose and dissolves in water to form a viscous colloidal solution (sol); while bassorin swells to form a thick gel (Weipig & Branwell, 2000). This

gum is highly susceptible to bacterial contamination, and preparations contaminated with enterobacteria have been reported to have caused fetal deaths when administered intraperitoneally to pregnant mice (Leung, 1980). In addition, it has been used since ancient times as an emulsifier, thickening agent, and suspending agent (Leung, 1980; Nuttall, 1993). Today, it is used extensively in foods and dressings and to thicken ice-cream.

The bakery industry is one of the largest organized food industries all over the world and in particular biscuits, cookies and cakes are the most popular products because of their convenience, ready-to-eat nature, and long-shelf life. The useful life of sponge cake is approximately one month before mould spoilage appears. All negative changes in quality are associated with staling. Although a considerable number of authors have associated staling with starch retrogradation, wheat proteins and lipids also seem to play a significant role in its development (Fizman *et al.*, 2005).

In recent years, an increasing tendency in bakery products with improved dietary value, for example fiber-enriched products, has been observed. Dietary cakes and other bakery products have been investigated using cereals fiber with different sizes and sources (Gomez *et al.*, 2010, Skendi *et al.*, 2009, Skendi *et al.*, 2010), dietary fiber and bran from some cereals (Lebsi & Tzia, 2011), several hydrocolloids (Gomez *et al.*, 2007) and oat β -D-glucan-enriched products (Sánchez-Pardo *et al.*, 2010) have been used. Results of the mentioned studies show that soluble dietary fibers can improve physical and sensorial properties of bakery products.

In present study, the effects of adding tragacanth gum on the textural properties and staling commercial sponge cake during storage were investigated.

2. Materials and Methods

2.1. Ingredients and additives

Commercial white flour (11.22% moisture, 0.55% ash, 9.13% protein, and 24.6 gluten index), vegetable oil (none hydrogenated), sugar, whole egg, invert syrup, gluten, non-fat dried milk, and tragacanth gum purchased from the local market.

2.2. Cake preparation

Table 1 shows the base batter formulation. Control sample has no added hydrocolloid and the rest has 0.1, 0.2, 0.3, 0.4, 0.6, and 0.8% (w/w) tragacanth gum in the cakes' batter.

The batters were prepared as follows: at first, all of the sugar, egg and vanilla were mixed for 3 minutes and then other solid substances were added. Next, the remaining liquids were added and mixed for another 3 minutes. After that, the batter was filled into molds (11.5 x 6.2 x 2.7 cm) and baked in an industrial oven for 15 minutes at 200°C. Then it was cooled at room temperature for 2 hours. The fresh cakes were packaged and stored at ambient temperature for 30 days.

Table 1. Basic formulation for commercial sponge cakes

Ingredient	Amount (g)
Flour	481.5
Vegetable oil	192.0
Sugar	271.5
Egg	151.5
Water	231.8
Invert syrup	48.0
gluten	15.8
Other ingredients	108.8

2.3. Texture profile analysis

Texture profile analysis to 50% compression were done on the samples (with the dimensions 20 x 20 x 20 mm) using Brookfield CT3 Texture analyzer¹ equipped with TA 25/1000 probe and TA-BT-KIT fixture. A test speed of 0.5mm/s and a trigger load of 5g were the selected settings. Cake cubes were compressed twice to give a TPA from which the primary textural parameter was obtained: Hardness (cake firmness), was calculated by the Texture-meter software.

2.4. Cutting test

The test was performed by placing cake cubes (with the dimensions 20 x 20 x 20 mm) on a TA-BT-KIT fixture for through testing; the samples were cut with a TA/53 probe for two series of cutting test, one for the crust of the slices that the probe descended 5 mm and the another for the crumb of the cake cubes that the probe descended 10 mm. The test speed was 0.5 mm/s and the trigger load was set at 5g.

1. Brookfield engineering, Middleboro, USA

2.5. Statistical analyses

All data were analyzed with the SPSS ver. 17.0 software package. Comparisons amongst means of samples were done by ANOVA (Analysis of Variance) using the Duncan's multiple range tests. Significant differences amongst mean values were considered at $p \leq 0.05$. All measurements were repeated in three times for each cake type.

3. Results and Discussion

3.1. TPA test

The results of TPA test indicated certain changes took place in the samples over the storage time and distinguished the samples prepared with different levels of tragacanth gum, as described in Figure 1. The Hardness parameter of cakes (Fig.2), including tragacanth gum up to 0.4% both on the 10th and 30th day was significantly softer than the control sample, but increasing the concentration of tragacanth gum from 0.4 to 0.8% leads to increasing the firmness of cakes.

Decreasing the cake firmness was more pronounced when tragacanth gum added to wheat flour would compete for water with native wheat starch granules in the dough. This in turn, might restrict swelling and solubilisation of the starch during baking, and thereby reduce firmness (Gill *et al.*, 2002). Increasing hardness of the cake crumb having tragacanth gum, at a high level of addition, may be a consequence of the thickening of the walls surrounding gas cells, as suggested by Rosell, Rojas, and de Barber (2001). Similar results have been reported by Gomez *et al.* (2010) and Lebsi *et al.* (2009).

3.2. Cutting tests

In this study, to understand the differences between an outer zone – the crust – and an inner zone – the crumb-, Cutting tests were used. The crust cutting force (Fig.3) and the crumb (Fig.4) of samples with tragacanth gum up to 0.4% on the 10th and 30th day are significantly lower than the control sample and cakes supplemented with 0.6 and 0.8% tragacanth gum have not significant difference with control sample, indicating that the tragacanth gum was highly affected on the inhibition of water migration from the crumb to the crust and

maintaining freshness. The reason of increasing the crust cutting force in higher concentration of gum returned to nature of gum that absorbed high water and created viscose environment and then produced firm samples (Gomez *et al.*, 2007).

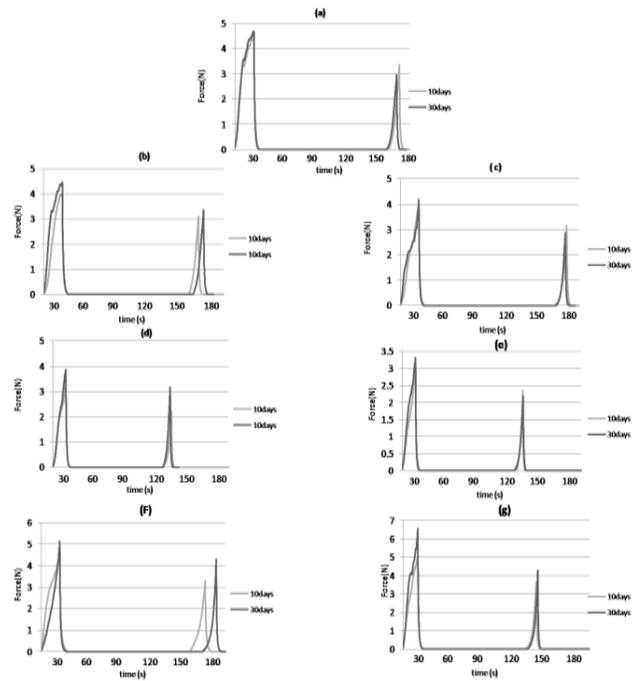


Fig 1. Fifty percent compression TPA parameters' values of cakes supplemented with tragacanth gum at different storage times.

(a) Control sample, (b): 0.1%, (c): 0.2%, (d): 0.3% and (e): 0.4%, (f) 0.6%, (g): 0.8% tragacanth gum.

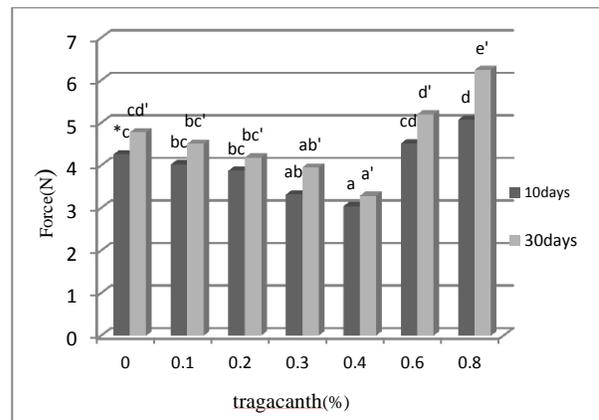


Fig 2. Hardness value of cakes at different storage times *Small letters show significant difference ($p < 0.05$) amongst samples.

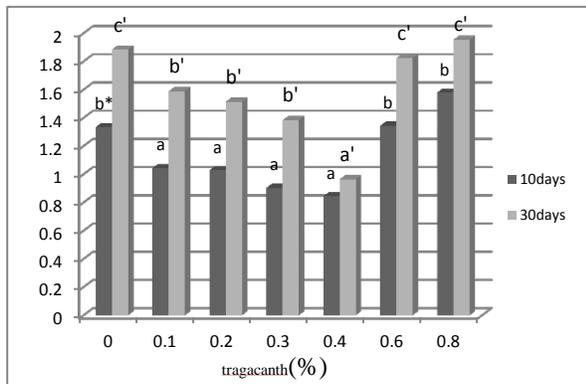


Fig 3. Cutting parameters' force of cakes' crust at different storage times.

*Small letters show significant difference ($p < 0.05$) amongst samples.

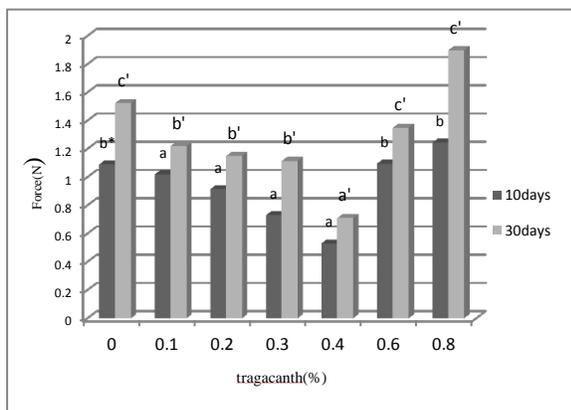


Fig 4. Cutting parameters' force of cakescrumb at different storage times.

*Small letters show significant difference ($p < 0.05$) amongst samples.

4. Conclusion

Results of this study indicated that the addition of tragacanth gum (> 0.4%) to commercial sponge cakes softened the samples with attenuated signs of aging. Therefore we can use tragacanth gum in cakes for providing better textural properties inside its potential health benefits.

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