Journal of Food Biosciences and Technology,
Islamic Azad University, Science and Research Branch, Vol. 7, No. 1, 73-79, 2017

The Effect of Marve Seed Gum (Salvia macrosiphon Boiss) on the Qualitative and Rheological Properties and Staling of Baguette Bread

V. Esmaielifard [a], B. Ghiassi Tarzi [b*], R. Azizi Nezhad [c]

[a] *M.Sc. of the Department of Food Science and Technology, Science and Research Branch, Islamic Azad University, Tehran, Iran.*
[b] *Assistant Professor of the Department of Food Science and Technology, Science and Research Branch, Islamic Azad University, Tehran, Iran.*
[c] *Assistant Professor of the College of Agriculture and natural Resources, Science and Research Branch, Islamic Azad University, Tehran, Iran.*

Received: 21 February 2016 Accepted: 25 April 2016

ABSTRACT: Functionality of Marve seed gum (Salvia Macrosiphon Boiss) on rheological properties and staling of Baguette bread have been studied. Three different concentrations of 0.1 %, 0.5% and 1% (w/w, flour basis) were applied and this hydrocolloid affected the quality of the stored bread to some extent. The effects of Marve seed gum on the rheological properties of dough was also investigated instrumentally by using two different techniques (farinograph and extensigraph). The effects of hydrocolloid on physical properties of bread were established by measuring the texture, crust colour and volume of baguette bread after baking. Texture and crust colour of baguette were respectively evaluated instrumentally through a texture analyser (TA) test and Hunter-lab instrument. Hedonic and descriptive sensory test of texture (odor, flavour, appearance and overall acceptance), were also carried out. All of the evaluations on baguette bread, were applied, 1 day, 3 days and 5 days after baking. In addition, good sensory properties for visual appearance, aroma, flavor, crunchiness and overall acceptability were obtained with 0.1% addition. There isn't a significant difference ($p<0.05$) between the control and 0.1% addition in the colour of bread. Texture analyses have shown that the addition of 0.1% Marve seed gum can keep the bread texture more acceptable than other breads, the most differences in 5 days after baking and less in 1 day after baking between 0.1% addition and the blank. In general, it can be concluded that with the addition of 0.1% Marve seed gum to the formulation, more qualitative parameters have been improved.

Keywords: *Baguette Bread, Hydrocolloids, Marve Seed Gum, Rheology, Staling, Texture Analysis.*

Introduction

Bread is a product with a great nutritional value consumed worldwide. In order to extend its shelf life, either different recipe formulations or specific storage conditions might be applied. From caloric point of view bread is responsible for a great proportion of daily energy intake. Having a caloric content ranging from 239 kcal/100 grams (rye bread) to 282 kcal/100 grams (white wheat bread), bread could provide up to 50% of the daily recommended caloric intake. Some ingredients have been added to bread formula to improve the technological properties of dough and the final properties of produced bread (Gray & Bemiller, 2003).

The use of additives has become a common practice in the baking industry. The objectives of their use are to improve dough handling properties, increase the quality of fresh bread and extend the shelf life of stored bread (Rosell *et al*., 2001).

This study is an attempt to explore the functional properties of hydrocolloied which has been obtained from the seeds of Salvia Macrosiphon Boiss – and can be potentially used as a novel food ingredient.

[*]Corresponding Author: babakghiassi@hotmail.com

The genus Salvia contains more than 700 species, which about 200 out of them exist in Iran and is probably found in neighboring countries. Plants belonging to this genus are pharmacologically active and have been used in folk medicine all around the world. Wild sage seed (Salvia macrosiphon) is a small, rounded seed, which readily swells in water to give mucilage (Razavi *et al*., 2007) but very few formal studies have looked at this little seed, only the composition of essential oil of this species has been reported (Matloubi *et al*., 2000) and recently computer image analysis and physic-mechanical properties of the seed investigated (Razavi *et al*., 2010).

The present study has been carried out to evaluate the effect of Marve Seed Gum (Salvia macrosiphon Boiss) on the quality of Baguette bread and its potential application in retarding the staling process.

Materials and Methods

Marve seed gum was extracted from whole seeds using distilled water (water to seed ratio of 25:1–85:1) at the pH of 3–9. The pH was monitored continuously and adjusted by 0.1 mol/L NaOH and HCl, respectively, while the temperature of the aqueous system ranged from 25–80°C and was controlled within ±2.0°C using an adjustable temperature controlled water bath. Water was preheated to a designated temperature before the seeds were added. Extraction was carried out in three stages; in the first stage, the seeds (40 g) were mixed with 1000 ml water (25:1 W:S) at a specific pH and temperature and enough time (20 min) was given to complete water absorption occurrence. A soaking time of 20 min was selected based on the yield of preliminary trials. Separation of the gum from the swelled seeds was done by passing the seeds through a laboratory extractor (Model 412, Pars Khazar Com., Iran). Crude gum was collected and residual seeds immersed in remaining of water in two stages, according to water to seed ratio proposed for each run, and again was passed through the extractor. The collected crude gums from different stages were mixed, filtered and dried overnight in a forced convection oven (Model 4567, Kimya Pars Com., Iran) at 70°C (Bostan *et al*., 2010). The dried gum was then grounded, filtered and used for bread making.

Wheat flour containing 0.67% ash in dry matter, 11.7% proteins and 27% wet gluten and Marve seed obtained from the Agricultural Organization Karaj were used in this study. The dough was prepared according to the formulation with flour blend, salt (1%), dry yeast (1%), Marve seed gum (0.1, 0.5 or 1%) and water according to farinographic consistency 500 BU (Brabender Units).

The rheological characteristics of the dough were investigated using farinograph and extensigraph instruments based on the methods presented by AACC (1983) numbers 54-21 and 54-10.

The loaf volume was determined by using rape seed displacement method (AACC, 2000, Standard 10-05). This was carried out by loading sorghum grains into an empty box with calibrated mark until it reached the marked level and unloaded back. The bread sample was put into the box and the measured sorghum was loaded back again. The remaining sorghum grains left outside the box was measured using measuring cylinder and recorded as loaf volume in cm^3. The specific volume, volume to mass ratio, (cm^3/g) was thereafter calculated.

Hardness of the baked loaf samples were measured after 1, 3 and 5 days storage by using a manual penetrometer (10 KN M350-10 AT/CT, England). This analysis was accomplished at ambient temperature with a cylindrical probe (d= 6mm). The penetration rate was adjusted at 60 mm/min. The crust hardness is expressed as force (N) needed to penetrate the sample (Ptaszek & Grzesik, 2007).

The colour of bread was measured by using Hunter Lab Colorimeter on the first day after the bread was made. Hunter lab colorimeter values, L * (0=black, 100= white), a * (+value = red, -value = green) and b * (+value = yellow, -value = blue) were recorded and YI (Yellowness index), WI (White index) and ΔE (total color difference) were calculated (Ghodke & Laxmi, 2007).

$$YI = \frac{142.86\, b}{L}$$

$$WI = 100 - \sqrt{(100 - L)^2 + a^2 + b^2}$$

$$\Delta E = [(L\ st^* - L\ sam^{**})^2 + (a\ st^* - a\ sam^{**})^2 + (b st^* - b\ sam^{**})^2]^{0.5}$$

* Standard

** Sample

- Sensory evaluation

The loaf quality and sensory attributes were evaluated 1, 3 and 5 days after baking at room temperature. Sensory evaluation was accomplished by the 5-point hedonic scale determination by 10 panelists. The assessors evaluated the shape of the product, crust colour and thickness/hardness, crust/crumb odour and taste, crumb elasticity, porosity and colour.

- Statistical Analysis

The results were compared in a random design (samples were selected randomly) with 3 replications in analytical methods and 10 replications in sensory evaluation. For the mean comparison of averages and introducing the best sample, Duncan's new multiple range test was used. Statistical analysis of the data was carried out using SAS software.

Results and Discussion

Rheological characteristics reflect the dough properties during processing and the quality of the final product (Shahzadi *et al.*, 2005). The effect of Marve seed gum addition on dough rheology is summarized in Table 1. As shown in Table 1, water absorption was increased in three different concentrations of the gum. By increasing Marve seed gum the rate of dough development time and dough stability were increased and the degree of softening was reduced. The results show the positive effect of Marve seed gum on dough rheological characteristics and the gluten network. Considering the FQN number, whenever the quantity of this factor is greater, the quality of flour and dough is improved.

By adding Marve seed gum the FQN factor was increased and the highest increase was observed at the %1 treatment.

For the Extensograph test, each sample was stretched at 45, 90 and 135 minutes after the end of the mixing. This procedure was designed to simulate the fermentation period in the conventional bread baking. The following characteristics of the Extensograph are widely used for the determination of dough quality; Energy, the extensibility, expressed as the length of the curve until the point of rupture; the resistance at a fixed extension, maximum resistance and ratio number (Dempster *et al.*, 1952). The results of Extensograph analysis

Table 1. The effect of Marve seed gum rate on farinograph characteristics

	Marve seed gum rate (%)			
Rheological Properties	**standard**	**0.1**	**0.5**	**1**
Water absorption (%)	59.3	59.7	61.2	63
Dough development time (min.)	1.5	2	1.9	2.3
Dough stability (min.)	2.5	2.7	2.6	3.4
Degree of softening (10 min after begin)	94	75	87	67
Degree of softening (12 min after Max)	108	90	105	85
Farinograph quality number (FQN)	29	34	31	38

are shown in Table 2. The viscoelastic behavior of the dough was affected by Marve seed gum addition. In all the treatments except the treatment with 0.5%, the extensibility of dough was significantly decreased with an increase in the resting time from 45 to 135 minutes, probably owing to the water-biding ability of Marve seed gum. The results also showed that higher concentration of gum gave significantly longer extensibility. Table 2 shows the effect of Marve seed gum on dough resistance. With an increase in resting time from 45 to 135 minutes, this value for both control and gum-added samples was significantly increased. This value was also affected by Marve seed gum concentration. Among the treatments 1% and 0.5% addition showed the highest and the lowest effects on dough resistance value at all resting times, respectively. This might be due to the interactions between Marve seed gum and flour proteins. As the resting time has increased from 45 to 135 minutes, the dough deformation energy also has increased at the 0.5% addition (Table 2).

Loaf volume is regarded as the most important characteristic for bread since it provides a quantitative measurement of baking performance (Tronsmo *et al*., 2003). The influence of applied Marve seed gum on volume of the final product is presented in the Table 4. It was observed that by increasing the Marve seed gum, bread volume has decreased as compared to the control. This difference is not considerable in the treatment with 0.1 % addition of Marve seed gum.

The behavior of this gum seems to be opposing the results of the mechanical tests that showed the highest strength and elasticity for doughs supplemented with Marve seed gum. Wang & Sun (2002) found a strong correlation between maximum recovery strain of wheat doughs and loaf volume; i.e., wheat flours with a large bread volume exhibited greater dough recovery strain (Wang et al., 2002).

Other factors, such as biaxial extensibility, play a part in determining bread making performance (Janssen *et al*., 1996; Rouille *et al*., 2005). There is certainly an optimum value for the resistance to deformation; too high resistance can cause a limited and slow expansion of the gas cells during proofing (VanVliet *et al*., 1992). Thus, it seems that with the addition of Marve seed gum the dough system becomes too rigid to incorporate gases.

Table 2. The effect of Marve seed gum rate on extensigram characteristics.

Rheological Properties						
Extraction rate	**Time (min.)**	**Energy (cm^2)**	**Resistance to extension (BU)**	**Extensibility (mm)**	**Maximum resistance (BU)**	**Ratio Number**
Standard	45	96	392	139	534	2.8
	90	114	741	107	888	6.9
	135	101	842	95	917	8.8
0.1 %	45	102	466	138	564	3.4
	90	103	597	117	709	5.1
	135	94	723	99	789	7.3
0.5 %	45	62	268	138	335	1.9
	90	98	453	145	544	3.1
	135	103	555	145	667	3.8
1 %	45	116	517	137	643	3.8
	90	105	734	104	847	7.1
	135	117	915	100	996	9.1

Table 3. The effect of Marve seed gum rate on Hardness Index during storage

Treatments	Hardness Index (N)		
	1st day	3rd day	5th day
Control	13.28[b]	13.91[b]	8.39[b]
0.1% Marve seed gum	2.39[d]	2.08[d]	2.28[d]
0.5% Marve seed gum	4.38[c]	6.11[c]	4.32[c]
1 % Marve seed gum	49.20[a]	53.43[a]	46.50[a]

Values are the mean of three replications. Different letters in each column indicate significant differences ($P< 0.05$).

Loaf volume is regarded as the most important characteristic for bread since it provides a quantitative measurement of baking performance (Tronsmo *et al*., 2003). The influence of applied Marve seed gum on volume of the final product is presented in the Table 4. It was observed that by increasing the Marve seed gum, bread volume has decreased as compared to the control. This difference is not considerable in the treatment with 0.1 % addition of Marve seed gum.

The behavior of this gum seems to be opposing the results of the mechanical tests that showed the highest strength and elasticity for doughs supplemented with Marve seed gum. Wang & Sun (2002) found a strong correlation between maximum recovery strain of wheat doughs and loaf volume; i.e., wheat flours with a large bread volume exhibited greater dough recovery strain (Wang et al., 2002).

Other factors, such as biaxial extensibility, play a part in determining bread making performance (Janssen *et al*., 1996; Rouille *et al*., 2005). There is certainly an optimum value for the resistance to deformation; too high resistance can cause a limited and slow expansion of the gas cells during proofing (VanVliet *et al*., 1992). Thus, it seems that with the addition of Marve seed gum the dough system becomes too rigid to incorporate gases.

The addition of Marve seed gum resulted the increase of bread brightness (L*) with 0.5 % and 1% and a decrease in bread yellowness-blue (b*) with 0.1% as compared to the control (Table 5). The redness of the bread increased with the addition of 0.1% Marve seed gum (a*), however there is not a significant difference between 0.5 and 1% treatments as compared to the control. As presented in Table 5, YI and WI decreased with the addition of 0.1% Marve seed gum Therefore bread with 0.1% is darker than control.

Table 4. The effect of Marve seed gum rate on loaf volume of baguette bread

Treatments	Loaf Volume		
	1st day	3rd day	5th day
Control	5.681[c]	5.640[c]	4.730[c]
0.1% Marve seed gum	5.563[c]	5.547[c]	4.644[c]
0.5% Marve seed gum	3.764[b]	3.679 [b]	2.852[b]
1% Marve seed gum	2.315[a]	2.253[a]	2.196[a]

[a-c] Means in the same column followed by different letters were significantly different ($p<0.05$).

Table 5. The effects of Marve seed gum on bread brightness (L^*), yellowness-blue (b^*), redness (a^*), YI and WI.

Treatments	L*	a*	b*	YI	WI	ΔE
Control	56.56^b	8.93^{ab}	30.51^b	77.11^{ab}	46.15^{ab}	$0(0)^c$
0.1% Marve seed gum	51.77^c	10.55^a	26.75^c	73.83^b	43.83^b	$6.30(\pm2.64)^a$
0.5% Marve seed gum	61.27^a	7.05^b	33.97^a	79.22^a	47.98^a	$6.14(\pm3.74)^b$
1% Marve seed gum	60.72^a	7.14^b	34.54^a	81.36^a	47.19^a	$6.06(\pm2.22)^b$

[a-c] Means in the same column followed by different letters were significantly different ($p<0.05$).

Table 6. The effect of different amount of Marve seed gum on the bread sensory evaluation.

Treatments	points assigned to treatments		
	1^{st} day	3^{rd} day	5^{th} day
Control	4.25^c	3.07^b	1.85^a
0.1% Marve seed gum	4.47^c	4.20^c	3.87^c
0.5% Marve seed gum	3.90^b	3.30^b	2.92^b
1% Marve seed gum	2.70^a	2.35^a	1.85^a

[a-c] Means in the same column followed by different letters were significantly different ($p<0.05$).

The effect of the addition of various percentage of Marve seed gum on sensory properties of Baguette bread is shown in Table 6. Each attribute was scored from 1 (lowest) to 5 (highest). As shown in Table 6, on the first day after baking, the control and 0.1 % addition did not have significant difference but on the third and the fifth days after baking the panelists preferred bread with 0.1% Marve seed gum. At the end the results indicated that breads with 0.1% Marve seed gum were preferred by the panelists.

Conclusion

The characteristics of wheat flour and dough were modified to some extent by the addition of Marve seed gum. Dough with different percentage of Marve seed gum had pronounced effects on dough properties yielding a higher water absorption, dough development time, dough stability, FQN, extensibility and lower degree of softening as compared to the control. On the other hand the results indicated the positive effect of Marve seed gum on dough rheological characteristics and the gluten network. Marve seed gum addition at levels of 0.1%, 0.5% and 1%, also affected the texture of bread and the treatment with 0.1 % reflected a better effect as antistaling agent. According to the sensory evaluation, the addition of 0.1% Marve seed gum might provide acceptable bread. Furthermore, these breads have improved nutritional values and longer shelf life along with acceptable softness and taste.

References

Bostan, A., Razavi, S. M. A. & Rahbari, R. (2010). Computer image analysis and physic-mechanical properties of wild sage seed (Salvia macrosiphon). International Journal of Food Properties, 13, 308–316.

Dempster, C. J., Hlynka, L. & Winkler, C. A. (1952). Quantitative Extensograph Studies of Relaxation of Internal Stresses in Nonfermenting Bromated and Unbromated Doughs. Cereal Chemistry, 29, 39-53.

Ghodke, K. & Laxmi, A. (2007). Influence of additives on rheological characteristics of whole-wheat dough and quality of Chapatti (Indian unleavened Flat bread) Part I—hydrocolloids. Food Hydrocolloids, 21(1) 110-7.

Gray, J. A. & Bemiller, J. N. (2003). Bread staling: molecular basis and control. Comprehensive Reviews in Food Science and Food Safety, 2, 1-21.

Gujral, H. S. & Pathak, A. (2002). Effect of Composite Flours and Additives on the Texture of Chapatti. Journal of Food Engineering, 55, 173- 179.

Janssen, A. M., van Vliet, T. & Vereijken, J. M. (1996). Rheological behaviour of wheat glutens at small and large deformations. Comparison of two glutens differing in bread making potential. Journal of Cereal Science, 23, 19–31.

Matloubi Moghaddam, F., Amin, Gh. & Safavipoorsohi, E. (2000). Composition of stembark essential oil from Salvia macrosiphon Boiss. Iranian Journal of Daru, 8, 28–29.

Ptaszek, P. & Grzesik, M. (2007). Viscoelastic properties of maize starch and guar gum gels. Journal of Food Engineering, 82, 227-237.

Razavi, S.M.A., Farhoosh, R. & Bostan, A. (2007). Functional properties of hydrocolloid extract of some Iranian seeds. Research project No.1475. Unpublished report. Ferdowsi University of Mashhad, Iran.

Rosell, C., Rojas, J. & Benedito, F. (2001). Influence of hydrocolloids on dough rheology and bread quality. Food hydrocolloids, 15, 75-81.

Rouille, J., Della Valle, G., Lefebvre, J., Sliwinski, E. & vanVliet, T. (2005). Shear and extensional properties of bread doughs affected by their minor components. Journal of Cereal Science, 42, 45–57.

Shahzadi, N., Butt, M., Rehman , S. & Sharif, K. (2005). Rheological and Baking Performance of Composite Flours. International Journal of agriculture and biology, 1560–8530.

Tronsmo, K. M., Faegestad, E. M., Schofield, J. D. & Magnus, E. M. (2003). Wheat protein quality in relation to baking performance evaluated by the Chorleywood bread process and a hearth bread baking test. Journal of Cereal Science, 38, 205–215.

VanVliet, T., Janssen, A. M., Bloksma, A. H. & Walstra, P. (1992). Strain hardening of dough as a requirement for gas retention. Journal of Texture Studies, 23, 439–460.

Wang, F. C. & Sun, X. S. (2002). Creep-recovery of wheat flour doughs and relationship to other physical dough tests and bread making performance. Cereal Chemistry, 79, 567–571.