The effect of applying guar gum, wheat fiber, and citric acid on the shelf-life, specific volume and sensory evaluation of Iranian croissant

Sanaz salmanizadeh, Shima.Moazzezi, Leila Nateghi
Department of Food Science and Technology
Varamin-Pishva Branch, Islamic Azad University
Varamin, Iran
sz.sanaz@gmail.com

Abstract: This study was aimed at examining the effect of applying guar gum, wheat fiber and citric acid on the shelf – life and sensory evaluation of croissant bread. To do so, different percentages of wheat fiber (0.10%, 0.15%, 0.20% , 0.25%) , guar gum (0.25%, 0.30% , 0.40% , 0.5%) and citric acid (0.10%, 0.15%, 0.20%) were added to the flour of the croissants and their staleness sensory was evaluated from the 1st till the 9th week. Also, pH value, aw value , sensory quality (shape, odour, colour, taste, consistency, crust, crumb) and the volume of the produced croissants were examined . Immediately after produce The results showed that the volume of croissants containing these compounds increase significantly compared to the control sample, while their water activity and pH value decreased significantly as water activity and pH value decreased from 0.85% and 6.32 for control sample to 0.77% and 5.20 for the formulation of sample 4, respectively. On the other hand, water holding capacity of croissants containing wheat fiber and guar gum increased significantly compared to the control sample as it increased from 23.52% to 9.87 for the control sample and from 21.52 to 16.59 for the formulation 4 following 9 weeks. The statistical results of shelf-life evaluation showed an increase in shelf-life of croissants from 3 week to 3 month.

Key words: croissants, guar gum, wheat fiber, citric acid, shelf-life

Introduction

Croissant is a fermented layered product often containing ingredients such as flour, salt, water, yeast, shortening, sugar, egg, non-fat milk powder, margarine or butter. (Rijkatt, 1984) Fermented layered doughs are made in a method in which fat is scattered between dough layers in process of rolling and laminating giving the final product with a flak texture. (Gisslen Wayne 2009) The used ingredients and their proper amounts have great effects on the quality of the final product as selecting pure wheat flour (uniform granulation) with a proper strength is preferred. W factor of at least 220 with a 0.6 ratio results in doughs with high expansion and a desirable appearance. Enzymatic activity in flour needs to be weak with a falling number of ≥ 250 s. Also fats used for making croissants (butter or margarine) must have good plasticity and stability. Moisture content of butter and melting point of margarine must not exceed 15% and 36 °C, respectively. (Raymond Cavel.,2001) Shelf-life of bread is limited by physicochemical changes such as staleness and microbial contamination. (Brummer& Lorenz., 1991) Many researchers have attempted to maintain high quality of bread through changing the formulation processing or packaging. One of the preservatives used in bread is calcium propionate that prevents molds growth in fermented bread with insignificant effect on the yeasts. Its optimum pH value is 5.4 to 5 and the used amount must not exceed 0.3%.(cauvain ,2003) Using preservatives such as hydrocolloids is one of the most effective methods of keeping the quality and increasing shelf-life of bread Barcenas & Rosell 2005). Use of gums as the baking improvers is growing worldwide because of their benefits such as increasing water holding capacity, improving food texture, and extending shelf-life of the final products. Smita et al., (2008)Hydroxyl groups of hydrocolloids retard bread staleness through hydrogen bonds with water molecules.) (Tavakol pour & ashtari 2006)The type and amount of hydrocolloids used in bread depend on the type of bread and the flour properties. Hydrocolloids commonly are used in voluminous bread to improve the texture, strengthen gluten network, make the bread soft and uniform, and retard staleness. (Kohajdora and Karovicova (2009) .Smita et. al., (2007) examined the effect of guar, carboxyl methyl cellulose, hydroxyl propyl methyl cellulose and carageenan on the quality of chapatti (an Indian bread) and reported an increase in water holding capacity and texture softness following adding hydrocolloids. Barzegar and Mohammad Hojjati (2008) also examined the effect of hydrocolloids such as guar pectin and xanthan at 0.5% and 1% on the rheological properties of dough and quality of Baggett bread. Xanthan gum showed the greatest but not the best effect followed by guar gum. Examining the samples kept for 24 and 48h showed that the hydrocolloids would prevent stableness and firmness of bread samples. The sample containing 0.1% of guar gum showed the least staleness. In general, dietary fibers in corporate in the systems consisted of water and flour may be involved in protein accumulation over heating such as a space in the gluten occupied by proteins, and affect the properties of starch dough such as peak, break, and final viscosity. They also may retard the required temperature for gelatination and retro gradation (Santos et. al., 2008). Vegetable fibers have functional properties including water holding capacity

(WHC), swelling capacity (SWS), increasing viscosity and / or gel formation Gallaher and Schneeman (2001) all resulting from their porous network structure formed by polysaccharide chains so that they are capable of holding high amount of water via hydrogen bond or water may be hold in capillary structure of fibers through surface absorption. lopez et al., (1996) Since the optimum pH for yeast activity in bread is 4.5-5) 2003 وcauvain(.a formulation containing natural elements (acids and some sugars) is used to adjust pH and activity of water and improve the fermentation process in order to improve quality and extend shelf-life of the baked products. (Wehrle et al 1997). Barber et. al., (1992) reported that adding acids resulted in reduced bread volume such that this decrease depends on the type of acid rather than pH value. In fact, pH value plays an important role only when it is < 4.5 . In general, preventing effect of some acids such as citic acid on the fermentation of yeasts is predominant. This undesirable effect of acidifiers on the volume of bread is likely due to insignificant effect of low pH value on the activity of yeast (decrease in Co2 production) and gluten protein (and higher solubility of gluten at low pH conditions) and lower preserved Co2 in bread. Brandt, Markus. J. (2006). The optimum conditions for improving bread volume include pH value at 5.1-5.5 corresponding to the results obtained by Clarke (2003).Clarke et. al., (2002) stated that the type and amount of acidification affected the volume of bread. Rahimi et. al., (2009) also studied the effect of different acidifiers (acetic, citric, lactic acids) on the specific volume and fermentation parameters of bread dough and observed that addition of 0.5% citric acid resulted in reduced pH and increased bread volume. Also citric acid was more effective than acetic acid. PK a and different degrees of purity were contributed to the different effect of the acids. The aim of this study was to reduce pH value by adding citric acid to the formulation in order to improve the activity of yeast and calcium propionate, increase the volume and shorten the time of fermentation. Also the addition of guar gum and wheat fiber resulted in increased water holding capacity and retarded staleness and reduced aw.

Materials and Methods

The flour used to produce croissant bread was of bakery type purchased from Gonbad Flour Company. Guar gum was prepared by Danisco co., Denmark, wheat flour by IRs Co., Germany, activated dry yeast by Fariman Co., Mashhad, monohydrate citric acid (as white powder) by china, and the improver of special croissant bread was prepared by Golnan peratus company.

Flour Physicochemical analysis

Flour physicochemical characterizations were: The Moisture content by the AACC method No. 16-44, the ashes content according to AACC No: 01-08, the fat content by AACC No. 10-30, the pH value by AACC No. 02-52, and protein content was determined according to AACC No. 12- 46. The wet gluten and precipitation of flour were determined according to AACC methods No. 11- 33 and No. 116 respectively.

Dough preparation

Doughs were prepared using the experimental mixer, Duesna, for 9 min. (slow speed for 4 min and rapid speed for 5. min) according to the formula given in table1. The doughs were laminated with 32 layers using the sheeter. Croissants, 8 × 16 cm weighing 55g, were put in the fermentation room. The samples were put in the fermentation room for 75 min at 42 °C and 85% RH. The samples finally were baked in the rotary oven (made by Germany) at 197°C for 20 min.

2.3. croissants Physicochemical analysis

Croissants physicochemical characterizations were: The Moisture content by the National Standards of iran No. 2705, aw content according to National Standards of iran No: 9657, the pH value by AACC No. 37.

3.3. Sensory evaluation

In this study the samples were coded after cooled and cut and then evaluated by five trained panelists. The produced croissants were evaluated on the basis of Iranian national standard of layered fermented baked products as follows. The properties of crust (uniform golden color without any spots) taste, odor, and uniformity of texture were assessed by the panelists, so that they gave scores for each attribute as 5 (best) to 1 (worst).

3.4. Sensory staleness evaluation

For sensory evaluation, staleness, aroma and flavor of the samples were assessed by the panelists from the first to the ninth week so that they gave scores as 5-5.4 for very fresh, 4.5-4.9 for flesh 4-4.4 for relatively stale and 3.5-3.9 for very stale. Specific volume of bread is one of the quality factors such that the more voluminous, the more desirable the bread.

croissants specific volume evaluation

Specific volumes of the samples were evaluated. Fermentation time is calculated from entering the samples into the fermentation room (at 40°C and 85% RH). Dough rise in the fermentation container and appearing abundant bubbles on the surface of dough and a spongy texture in the dough may indicated that the dough is prepared.

Experimental design and statistical analysis

The experiments were conducted in a completely randomized design with 10 treatments in triplicate using systematic methods and in five replicates using sensory methods. First, one-way variance analysis and then means comparison test, of Duncan type, at 5% significance level were conducted. The statistical analyses were conducted using SPSS and Microsoft office excel software.

Results and discussion

Results

The results of the flour physicochemical tests are given in table 1 showing the suitability of the flour used to produce croissants. The results of the croissants volumetric test, pH, aw, Overall acceptability of croissants are presented in Table 3.
As shown in table 2, sample No.4 and the control sample, without any improvers, have the highest and the lowest specific volume respectively. (Except in the control and treatment 4 was no significant difference among other treatments) Also, the addition of citric acid resulted in reduced pH value of the treatments significantly such that pH value of the control sample decreased from 6.32 to 5.20 in the treatment No.4. The percentage of aw should not exceed 0.78% to meet the national standard (3493) while only treatment No.4 showed the standard aw percentage following addition of these compounds. Although statistically significant differences were observed with treatment 3) According to the panelists There was no significant difference between Overall acceptability of croissant treatments .

Discussions

Increased wheat fiber and guar content increases water absorption as a result of network structure of fibers consisted of polysaccharide chains holding high amount of water by hydrogen bonds (kethireddipalli et al., 2002) or water may be held in capillary structures of fibers through surface absorption (lopez et al., 1996). In addition, water absorption of all samples containing fiber with gums is higher than the control sample without fiber. This increase in water absorption may be due to hydrophilic structure of gums and higher content of fiber. Hydroxyl groups of hydrocolloids are bound to water molecules through hydrogen bond and increasing water absorption (Tavakol pour & Ashtari, 2006) It also increases the water holding capacity in croissants. Since the fibers are able to absorb water and release over time therefore can delay the staling of croissants .
The results of croissants volume evaluation revealed that the produced croissants were more voluminous than the control sample. This is because of better activity of yeast at lower pH value resulted from addition of citric acid and also because of improved gluten network due to addition of guar gum. This is likely because the used acid resulted in produced bread with pH value > 4.5 indicating that citric acid used in the formulation had no undesirable effects on the structure of bread gluten and its efficacy for retaining Co2 while providing desirable pH for propionate activity. In addition, the shelf-life of croissants at ambient temperature (25°C) increased because of exposing to calcium propionate at the optimum pH value so that molds were developed on the control sample, treatments 1 and 2 and treatments 4 and 5 after 21d, 45d, and 3 mo., respectively. Crust, taste, odor and texture of bread were evaluated by the panelists. The added compounds increased the volume and porosity of most samples showing a significance difference of sensory properties, softness, and freshness, compared to the control sample making the final product more acceptable.

REFERENCES

[1] Barber, B. Ortola, C., Barber, S. and Fernandez, F. (1992). Storage of packaged white bread. III Effects of sourdough and addition of acids on Bread characteristics. Zeitchcrift fur Lenensmittel Unterschung undForchang 198, 442- 449

[2] Brummer, J-M. and Lorenz, K. (1991). European developments in wheat Sourdoughs. Cereal Food world, 36, 310-314.

[3] Barcenas M, Rosell CM. Effect of HPMC addition on microstructure, quality and aging of wheat bread. Food Hydrocolloids. 2005; 19(6): 1037- 1043.

[4] Brandt, Markus. J. (2006). Sourdough products for Convenient use in baking. Food Microbiology 24(2007) 161-164
.

[5] Calvel, R. et al. (2001) The Taste of Bread .

[6] Cauvain,s.p. 2003.Bread Making .Wood Head publishing, England ,pp:562-570,1460-1479.

[7] Clarke, C. I, Schober, T. J. and Arendt , E.K.(2002). The effect of single strain and traditional mixed strain starter cultures on rheological properties of wheat dough and bread quality. Cereal Chemistry 79, 640-647

[8] Gorinstein S, Zachwieja Z, Folta M, Barton H, Piotrowicz J, Zemser M, Weisz M, Trakhtenberg S, Màrtín O. Comparative contents of dietary fiber, total phenolics, and minerals in persimmons and apples. Journal of agricultural and food chemistry.2001;49(2):952-7.

[9] Gallaher D, Schneeman BO. dietary Fibre. In B. Bowman & Russel (Bds) , Present Khowledge in nutrition (& thed. , PP. 805). Washing ton, DC. 2001.ILSI.

[10] Kohajdova. M, Karovicova 1. .2009. Application of hydrocolloids as baking imporovers, chemical Papers, 63 (1) , 26-38

[10] Kethireddipalli, p., Hung, Y. C. Phillips, R. O. & mcwaters, K. H .(2002).Braluating the role of cell material and soluble protein in the fun ctionality food science, 67(1) . 53-59.

[11]Lopez,G.,Ros,G.,Rincon,F.,Periago,M.j.,Martinez,M.C, &Ortuno,j.(1996).Relationshipbetween physical and hydration properties of soluble and insoluble fibre of artichoke.journal of Agricultural and Food chemistry,44,2773-2778

[12] Rahimi, N, Karimi, M. 2, Poorazarang, H. 2008.An investigation and comparision of the effects of organic acids and Sourdough on fermentation properties and Specific volume of barbari bread,71-79

[13] Smita, S., Rajiv. J. Begum K. Indrani D. 2008 . Effect of hydrocolloids on rheological, micro structural and quality characteristics of parotta – an unleavened Indian flat bread, Journal of texture studies , 39 : 267-283.Technology and biotechnology, vol. 45, p. 426,433

[14] Santos, E., Rosell, C. M., & Collar, C. 2008. Retro gradation kinetics of high fibrewheat flour blends: A calorimetric approach. Cereal Chemistry, 85(4), 450–458.

[15] Tavakol pour H., Kallbasi – Ashtrari A.2006. Influence of gums on dough properties and flat bread quality of two Persian Wheat rarieties , journal food process engineering, 30 , 74 -87.

Table 1- the formulations applied to produce croissants (on percent)

ingredient	control	Treatment1	Treatment 2	Treatment 3	Treatment 4
Flour	100	100	100	100	100
Yeast bakery	3.75	3.75	3.75	3.75	3.75
Sugar	6.25	6.25	6.25	6.25	6.25
Salt	1.30	1.30	1.30	1.30	1.30
Egg	1.75	1.75	1.75	1.75	1.75
Oil	2.50	2.50	2.50	2.50	2.50
Water	40	40	40	40	40
Margarine	21	21	21	21	21
Citric acid	---------	0.15	0.20	0.25	0.25
Guar gum	---------	0.25	0.30	0.40	0.50
Wheat fiber	---------	0.10	0.15	0.20	0.25
Bread improver	2	2	2	2	2
Propionate calcium	0.10	0.10	0.10	0.10	0.10

Table 2. Chemical properties of wheat flour (on percent)

Sample	Moisture (%)	Ash (%)	Wet Gluten (%)	Protein (%)	Fat (%)	Sedimentation unit (ml)	pH (%)	Falling Number (sec)
wheat flour	13.4	0.65	32.8	12.4	2.6	28-30	6.2	612

Table 3. The results of the croissants volumetric test, pH, aw, Overall acceptability of croissants

	control	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Specific volume (gr / cm^3)	331.14±1.40^{a}	339.27±2.15^{ab}	347.81±1.23^{ab}	352.84±4.21^{ab}	359.71±2.03^{b}
pH	6.32±0.01^{a}	5.91±0.00^{b}	5.71±0.00^{c}	5.50±0.01^{d}	5.20±0.01^{e}
aw (%)	0.85±0.00^{a}	0.83±0.01^{ab}	0.81±0.01^{bc}	0.79±0.00^{cd}	0.77±0.00^{d}
Overall acceptability of croissants	3.97±0.22^{a}	4.05±0.27^{a}	4.19±0.21^{a}	4.28±0.37^{a}	4.39±0.27^{a}

The values reported are mean ± SD
aw: active water

Table 4. The results of staleness sensory evaluation

	0day	7days	14days	21days	28days	35days	42days	49days	56days	63days
control	5.75±0.31^{a}	5.40±0.20^{ab}	4.9±0.00^{abc}	4.70±0.10^{bcd}	4.60±0.25^{bcd}	4.50±0.10^{bcd}	4.30±0.25^{dc}	4.10±0.10^{cd}	4.00 ± 0.18^{cd}	3.80±0.10^{d}
Treatment 1	5.75±0.19^{a}	5.40±0.00^{ab}	5.00±0.20^{abc}	4.90±0.15^{abcd}	4.70±0.0^{bcd}	4.60±0.15^{bcd}	4.50±0.15^{bcd}	4. 30±0.25^{cd}	4.10±0.15^{cd}	4.00±0^{d}.25
Treatment 2	5.75±0.32^{a}	5.40±0.21^{bc}	5.1±0.10^{abc}	5.00±0.0^{abc}	4.90±.10^{abc}	4.70±0.25^{abc}	4.60±0.30^{abc}	4.40±0.10^{bc}	4.20±0.22^{c}	4.10±0.30^{c}
Treatment 3	5.70±0.20^{a}	5.60±0.11^{ab}	5.1±0.20^{abc}	5.00±0.35^{abc}	4.90±0.25^{abc}	4.80± 0.15^{abc}	4.70±0.0^{abc}	4.60±0.15^{bc}	4.30±0.25^{c}	4.30± 0.15^{c}
Treatment 4	5.75±0.10^{a}	5.60±0.17^{ab}	5.1±0.10^{ab}	5.10±0.30^{ab}	5.00±0.15^{ab}	4.90±0.30^{ab}	4.80±0.10^{ab}	4.70 ±0.30^{c}	4.60±0.0^{c}	4.60 ±0.02^{c}

The values reported are mean ± SD