The effect of applying gluten, wheat fiber and vinegar on the shelf-life, specific volume and sensory evaluation of Iranian strudels

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: In this study four level of gluten (0.5,0.75,1,1.5%),wheat fiber (0.75,1,1.25,1.5%) and vinegar (0.25,0.5,0.75,1%) were added to the flour of Iranian strudels and the shelf-life, specific volume and sensory evaluation of them were investigated. For this purpose strudels were baked and Specific volumes of the samples were evaluated (The rapeseed displacement method was used for measuring the specific volume of the samples) and their staleness sensory was evaluated from the 1st till the 9th week. Also, quality sensory evaluation, pH value, activity of water and the volume of the produced strudels were examined. . sample No.4 had the highest specific volume . Also, the addition of Vinegar resulted in reduced pH value of the treatments significantly such that pH value of the control sample decreased from 6.20 to 5.23 in the treatment No.4. The percentage of aw for treatment No.3 and treatment No.4 showed the standard aw percentage (should not exceed 0.78%) following addition of these compounds. (There was no statistically significant difference between them) The results of Sensory staleness evaluation demonstrated that the combination of gluten, wheat fiber, in the strudels significantly retard .

Keywords: gluten,strudels , wheat fiber, vinegar, shelf-life

Introduction

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 [20]. Pastries made from dough or phyllo doughs are even flaker than puff pastries. Unlike puff pastries, these desserts start out with paper-thin layers of dough that are brushed with fat and then stacked or up to make many layered creations. is an Eastern European pastry that begins as a soft dough made of strong flour, Eggs and water. After the dough is mixed well to developed the gluten, it is stretched by hand into a very thin, transparent sheet. 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. Moisture content of butter and melting point of margarine must not exceed 15% and 36 °C, respectively [7]. Flours with higher amounts of protein make better breads. Strong wheat flours, which contain a high percentage of protein, form elastic glutens with good gas retaining abilities and produce well-risen, well-shaped loaves of bread with good crumb grain and texture. Weak wheat flours have low protein contents, and form soft, weak, mainly non elastic glutens with poor gas retaining abilities [12].To produce bread with desirable characteristics such as a high loaf volume, and a light and even crumb, depends on the ability of the dough to retain the gas produced over long periods of time especially during fermentation, and oven rising. The ability of dough to retain gas is one of the most important quality requirements for bread making. Gluten is responsible for this ability because it provides the dough with the viscoelastic properties to hold gas[22]. Gluten properties are among the properties of flour that have the greatest influence on the viscoelasticity of dough. It is well established that several factors, such as disulphide bonds, hydrogen and ionic bonds and small Vander Waals bonds and hydrophobic interactions, are responsible for the development of the gluten network. Indeed, the unique viscoelastic properties of wheat flour doughs that allow leavened breads to be produced are closely associated with the properties of their gluten proteins. During mixing, these proteins are hydrated and develop into a continuous matrix that entraps other flour components and imparts the required viscoelastic and related properties that allow the dough to retain gas[17]. Since the optimum pH for yeast activity in bread is 4.5-5 [8]. 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. [21]. 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 vinegar 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 [5]. 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., (2003) stated that the type and amount of acidification affected the volume of bread [14]. 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% vinegar resulted in reduced pH and increased bread volume. The aim of this study was to reduce pH value by adding vinegar to the formulation in order to improve the activity of yeast and the addition of wheat fiber resulted in increased water holding capacity and retarded staleness and reduced aw. Being a readily available and inexpensive source of dietary fiber and antioxidant properties, wheat bran is widely used in cookies. However, it contains relatively lower dietary fiber, higher amount of crude fat and higher phytic acid content when compared to wheat fiber[15]. In conventional bread making, fiber replacement of flour disrupt the starch–gluten matrix and restrict and force gas cells to expand in a particular dimension[10]. affecting dough viscoelastic behavior and constraining dough machinability and gassing power [11]. The fiber source and the type and degree of processing are the main factors influencing functional properties (solubility, viscosity, gelation, water-binding and oil-binding capacities, mineral and organic molecule binding) [18]. Those characteristics have great impact on the functional quality of the intermediate manufacturing and end products when obtained by conventional bread making processes[11]. Attempts to add fiber into popular foods present challenges to develop products with a fiber level that meets the requirements of The Code of Federal Regulations (Title 21, Part 101.54), which allows “good source of fiber” and “excellent source of fiber” claims to be made for a product. Major technical challenges of incorporating fibers will be the maximum retention of functionality of added fibers in the final finished products. Therefore, the success of DF addition should be determined based on the biological and physical effects that DF may carry into the final products. Adding insoluble DF solely to baked products is limited because of its low functionality and fermentability, in comparison, soluble fibers can be fermented (by the large intestine micro flora) leading to desired metabolic effects[17]. Water holding capacity of soluble fibers (such as pectin and galactomannan) is greater than that of cellulose (insoluble fibers)[2]. Soluble fibers are normally added together with insoluble fibers to deliver the full spectrum of fiber functionality [6]. Added fibers have been found to influence the properties of other types of baked products, and these impacts may also occur to bread systems. Fibers derived from apple, lemon, and wheat have been added to cookies to replace the wheat flour on the levels of 15%, 20%, and 30% (w/w, based on the flour used), which showed that the in vitro protein digestibility decreased with an elevated fiber level [4]. The disruption of breadcrumb structure is due to the impairment in gas retention. Fiber addition caused shortened and low resistance to dough extension, and increased concentration of insoluble and soluble cell wall materials have been shown to partially disrupt the gluten network[11]. Hydrocolloids fall within that category, exerting great effect on bread making performance and bread quality [16]. The physical properties of fiber including water holding, oil holding, and swelling capacity, viscosity or gel formation significantly affect product processing and quality [21]. The addition of fibers to dough would alter dough's water absorption, causing reduced water content in dough and poor viscoelastic property. The addition of fiber may or may not decrease dough stability. Decreased dough stability and prolonged dough development time (from 4.2 to 5.8 min) were possible after the use of mango peel powder (rich in pectins) to replace flour at a level of 10% (w/w) [2]. Thus, the type of fiber determined its impact on dough stability, possibly due to the number of hydroxyl groups of fiber that interact with water through hydrogen bonding[22]. Investigated the incorporation of fiber from various sources into cookies and reported reduction in cookie spread with an increase of fiber content. Several other studies have reported similar effects of fiber incorporation on cookie spread [6].

Materials and Methods

The flour used to produce bread was of bakery type purchased from Gonbad Flour Company. wheat fiber by IRs Co., Germany, activated dry yeast by Fariman Co., Mashhad, and the improver of special strudels bread was prepared by Golnan peratus company. vital gluten was purchased from Cargill (Africa) and Vinegar obtained from yek o yek (Iran, shiraz).

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 10 min. (slow speed for 5 min and rapid speed for 5. min) according to the formula given in table1. The doughs were laminated with 32 layers using the sheeter. 12 × 22 cm weighing 70g, were put in the fermentation room for 75 min at 40 °C and 88% RH. The samples finally were baked in the rotary oven (made by Germany) at 205°C for 18 min.

Strudels Physicochemical analysis

strudels 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.

Sensory evaluation

In this study the samples were coded after cooled and cut and then evaluated by five trained panelists. The produced strudels 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).

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.

s specific volume evaluation

Specific volumes of the samples were determined using Rapeseed displacement method (AACC, 2000, Standard 10-05)

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 strudels. The results of the strudels volumetric test, pH, aw, Overall acceptability of strudels 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. (There was significant difference among control and other treatments) Also, the addition of Vinegar resulted in reduced pH value of the treatments significantly such that pH value of the control sample decreased from 6.20 to 5.23 in the treatment No.4. The percentage of aw should not exceed 0.78% to meet the national standard (3493) while treatment No.3 and treatment No.4 showed the standard aw percentage following addition of these compounds.(There was no statistically significant difference between them) According to the panelists There was no significant difference between Overall acceptability of strudel treatments .

As shown in table 5, Moisture content of the strudels increased following increasing of gluten and wheat fiber contents. Water holding capacity, also increased over storage because fibers It also increases the water holding capacity in strudels. Since the fibers are able to absorb water and release over time therefore can delay the staling of strudels. And the result The results of Sensory staleness evaluation (Table 4) demonstrated that the combination of gluten, wheat fiber, in the strudels significantly retard

Discussions

Increased wheat fiber and gluten 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) and . 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 strudels. Since the fibers are able to absorb water and release over time therefore can delay the staling of strudels.

The results of strudels volume evaluation revealed that the produced strudels were more voluminous than the control sample. This is because of better activity of yeast at lower pH value resulted from addition of Vinegar .This is likely because the used acid resulted in produced bread with pH value > 4.5 indicating that Vinegar used in the formulation had no undesirable effects on the structure of bread gluten and its efficacy for retaining Co2. 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

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

ingredient	control	Treatment1	Treatment 2	Treatment 3	Treatment 4
Flour	100	100	100	100	100
Yeast bakery	4	4	4	4	4
Sugar	5.25	5.25	5.25	5.25	5.25
Salt	1.50	1.50	1.50	1.50	1.50
Egg	1.90	1.90	1.90	1.90	1.90
Oil	2.35	2.35	2.35	2.35	2.35
Water	42	42	42	42	42
Margarine	22	22	22	22	22
vinegar	---------	0.25	0.50	0.75	1
gluten	---------	0. 5	0.75	1	1.5
Wheat fiber	---------	0.75	1.00	1.25	1.50
Bread improver	1	1	1	1	1
Milk powder	1.5	1.5	1.5	1.5	1.5
Invert sugar	1.5	1.5	1.5	1.5	1.5

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

Sample	(%) Moisture	Ash (%)	Wet Gluten (%)	Protein (%)	Fat (%)	Sedimentation unit (ml)	pH (%)	Falling (sec) Number
wheat flour	13.10	0.55	29.00	12.12	2.60	28-30	6.2	612

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

	control	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Specific volume (gr / cm^3)	121.12 ± 1.70^{a}	132.16 ± 1.25^{b}	151.92 ± 1.16^{c}	174.89 ± 2.24^{d}	188.71 ± 1.81^{e}
pH	6.20 ± 0.00^{a}	5.93 ± 0.01^{b}	5.75 ± 0.00^{c}	5.50 ± 0.00^{d}	5.23 ± 0.01^{e}
aw (%)	0.86 ± 0.01^{a}	0.83 ± 0.00^{ab}	0.81 ± 0.00^{ab}	0.78 ± 0.01^{ab}	0.76 ± 0.01^{b}
Overall acceptability of strudels	4.00 ± 0.32^{a}	4.15 ± 0.20^{a}	4.29 ± 0.25^{a}	4.31 ± 0.25^{a}	4.39 ± 0.17^{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	6.00±0.11^{a}	5.70±0.11^{a}	5.5±0.11^{ab}	4.30±0.12^{bc}	4.70±0.15^{c}	4.30±0.13^{c}	4.20±0.15^{c}	4.10±0.20^{c}	4.0 ±0.21^{c}	4.00±0.13^{c}
Treatment 1	6.00±0.18^{a}	5.70±0.04^{a}	5.60±0.12a^{a}	4.30±0.11^{ab}	4.80±0.09^{bc}	4.70±0.15^{c}	4.40±0.21^{c}	4. 30±0.15^{c}	4.10±0.12^{c}	4.00±0.25^{c}
Treatment 2	6.00±0.12^{a}	5.80±0.11^{ab}	5.6±0.15^{abc}	5.20±0.09^{abcd}	5. 0±.19^{abcde}	4.8±0.15^{abcde}	4.60±0.10^{bcd}	4.40±0.14^{cde}	4.20±0.12^{ed}	4.10±0.10^{e}
Treatment 3	6.00±0.10^{a}	5.90±0.21^{ab}	5.7 ±0.10^{abc}	5.30±0.15^{abcd}	5.2±0.15^{abcd}	5.0± 0.15^{abcd}	4.80±0.25^{bcd}	4.60±0.10^{cd}	4.30±0.14^{cd}	4.20± 0.12^{d}
Treatment 4	6.00±0.17^{a}	5.90±0.12^{ab}	5.8±0.17^{abc}	5.50±0.20^{abcd}	5.4±0.18^{abcd}	5.2±0.19^{abcd}	4.90±0.11^{bcd}	4.70 ±0.10^{cd}	4.50±0.04^{cd}	4.40 ±0.08^{d}

The values reported are mean ± SD

table 5.The results of the croissants moisture content during storage time

	0day	7days	14days	21days	28days	35days	42days	49days	56days	63days
control	23.27±0.05^{a}	22.35±0.27^{a}	21.10±0.23^{a}	20.05±0.10^{b}	18.07±0.12^{b}	16.13±0.21^{c}	15.17±0.11^{d}	14.12±0.17^{e}	13.20±0.11^{ef}	12.03±0.12^{f}
Treatment 1	23.36±0.14^{a}	23.07±0.14^{b}	22.68±0.11^{c}	21.41±0.25^{d}	21.25±0.20^{e}	19.09±0.17^{f}	17.15±0.07^{g}	15.20±0.12^{h}	14.12±0.16^{i}	12.42±0.20^{j}
Treatment 2	23.48±0.17^{a}	23.20±0.01^{a}	22.75±0.12^{a}	21.49±0.17^{b}	21.27±0.17^{b}	19.45±0.13^{c}	17.29±0.14^{d}	15.45±0.11^{e}	14.35±0.21^{f}	13.29±0.17^{f}
Treatment 3	23.65±0.16^{a}	23.25±0.17^{a}	22.83±0.15^{a}	21.53±0.25^{b}	21.40±0.11^{b}	19.61±0.16^{c}	17.36±0.17^{d}	15.71±0.16^{e}	14.54±0.16^{f}	14.43±0.15^{f}
Treatment 4	23.80±0.24^{a}	23.40±0.20^{ab}	23.10±0.22^{ab}	22.62±0.17^{b}	21.15±0.22^{c}	19.88±0.21^{d}	18.14±0.15^{e}	17.91±0.13^{e}	16.83±0.14^{f}	15.15±0.10^{g}

The values reported are mean ± SD