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Effect of Inulin and β-glucan on The Physicochemical, Rheological, and Sensory Properties Barbari Bread

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ABSTRACT

In this research, applications of inulin and beta-glucan fibers on Iranian Barbari bread quality as well as their potential to retard the staling, has been studied. Inulin and beta-glucan powders used in the preparation of the samples, respectively, at three levels of 2, 2.5 and 3% (w-w) and beta-glucan concentrations of 1, 1.5 and 3% (w-w). Tests performed include physicochemical tests relating to quality of flour including moisture, protein, ash, etc; rheological properties of dough, performed by Farinograph and Extensograph device. On rheological tests best of inulin percentage is 3% and beta-glucan percentages are (1.5–3) %. The combination of the two beta-glucan percentages and 3% inulin prepared, so as rheological measurements were mentioned. Based on the results of the rheological tests, dough bread contains beta-glucan 1.5% and inulin 3 % better characteristics showed however no significant difference before and after the treatment was found to contain beta-glucan 3% and inulin 3 %. Meanwhile, mix bread containing beta-glucan 1.5% and inulin 3, in terms of overall admissions have the utility does not differ significantly from control.

Keywords: Beta-glucan, Extensogeraph, Farinogeraph, Inulin, Rheology.

I. INTRODUCTION

Traditional breads is the most common products of wheat flour that determine the quality and durability is always emphasized. One of the most common types of traditional breads in Iran, Barbari bread is prepared by traditional process and fluctuations in quality baking flour is the importance various reasons so that waste is converted into bread. Main research question is whether it can be combined either by optimum combination of prebiotic inulin and dietary fiber beta-glucan in Barbari bread to improve its quality, while maintaining the sensory properties of the product is achieved?

Barbari bread has a higher specific volume than other types of flat breads, and a thickness of 2.5 cm appears. Iran standard for this type of bread because the bread component separated from the lower surface of the upper shell half- giant is classified, but non- starch polysaccharide compound beta-glucan composed of linear chains of glucose is linkages (1-3) β and (1-4) β .Inulin also a component of dietary fiber, linked (1-2) β and almost all molecules leads to glucose units (Wood et al., 1977). In connection with prebiotic substances that are indigestible or limited digestible by stimulating the growth or activity of one or a limited number of bacteria in the colon that can improve host health (Tamime, 2005). Prebiotic compounds as a secondary factor for the control of probiotic bacteria in the intestinal flora are considered (Crittenden et al., 2001). Prebiotic must be able to pass through the large intestine without digestion and absorption in the upper gastrointestinal tract by beneficial bacteria such as Lactobacillus and Bifidobacterium, and may consume (Thammarutwasik et al., 2009). What about the fairy antibiotics is important, the stimulatory effect of probiotics is their choice. A group of carbohydrates, dietary fiber are not degraded by human digestive enzymes but are fermented by colon microflora. Positive effect on the pH of the large intestine and fermentation byproducts produced by the physiological effects (Ahlborn et al., 2005). The term dietary fiber for the first time by researchers called Hipsley (1953) as components of the plant cell wall origin stated. Burkitt (1976), Trowell et al (1972) and other scholars of dietary fiber in the form of plant residues that are resistant to hydrolysis by human digestive enzymes, and therefore were defined as non-digestible ability of these compounds in the small intestine emphasized. This after numerous researches, scientists found that the relationship between dietary fiber intake and risk of colon cancer

and cardiovascular disease, there is a very close relationship (Izydorczyk& Dexter, 2008). Codex Alimentarius Commission (2006) reported that dietary fibers are carbohydrates with a degree of polymerization of at least 3. U.S. Association of Cereal Chemistry (AACC, 2000) as food and fiber ultra-pragmatic or especially introduced, because their nutritional properties, inhibiting or reducing a wide range of diseases. American Institute of Medicine of the total dietary fiber and fiber-fiber concept to practical application. Most compounds of prebiotic dietary fiber, but unlike the second group, probiotic, prebiotic, they stimulate the growth of microorganisms. Reportedly Codex Alimentarius (2006), based on synthetic oligosaccharides, maltose and galactose are also dietary fiber (Butt et al., 2001). Bran and whole grain cereals, fruits and vegetables are the main sources of dietary fiber has been suggested that continuous use. The grain structure, bark and buds highest amount of fiber there so refined flour, bran and germ removed because it contains less fiber (Butt et al., 2001). As two important dietary fiber and beta-glucan and inulin available is crucial for making valid research and a lot has been done on them.

In 2009, Skendi et al, investigated effect of beta-glucan enriched wheat flour, two different varieties (in two different molecular weight: BG-100 105 × 1 and: BG-200105 × 2.03) 0, 0.2, 0.6, 1, 1.4% on Greek bulk rheological properties and bread properties. Farinograph water absorption, dough and bread moisture content and water activity increased with increasing beta-glucan. Higher molecular weight beta-glucan (BG-200) compared with the other type was more effective. Add beta-glucan formula flour, dough development time, stability, resistance to deformation, stretching dough and bread specific volume increase. In 2009, Filipoovik et al, studied on sugar beet fiber and inulin addition of HPX, GR 5% for some rheological properties and its effect on the quality of frozen dough bread baguette is looked. The dough temperature - 18 ° C is frozen for 0, 1, 30 and 60 days was maintained. The results of the different components of the fiber traits in samples and control samples. Most of the fibers were observed after 30 days. Same time these compounds have the greatest impact in terms of volume and quality of the brain, bread, fresh dough (without freezing) were seen. The results showed that inulin HPX well distributed within the network, and possibly gluten, yeast cells from freezing on days 1, 30 and 60 preserves.

II. Materials and methods

2.1 Materials

Flour used in this study, the percent extraction flour Star Mansourian 82 percent. The study of active dry yeast fariman manufactured; fiber, beta-glucan by Britol China and inulin company Sensus Netherlands were used. Meanwhile, all materials in this experiment were from Germany MERC.In “Table 1” Total number of treatments that is 9 numbers plus the code is written. To perform the experiment in a completely randomized design with three replications was used.

Table 1: Details of treatments

	Code	Details of treatments
1	C	The control sample
2	I_M	Sample containing 2% inulin
3	I_A	Sample containing 2.5% inulin
4	I_H	Sample containing 3% inulin
5	B_M	Sample containing 1% beta-glucan
6	B_A	Sample containing 1.5% beta-glucan
7	B_H	Sample containing 3% beta-glucan
8	I_HB_A	Sample containing 3% inulin+ 1.5% beta-glucan
9	I_HB_H	Sample containing 3% inulin+ 3% beta-glucan

2.2 Methods

Free moisture according to standard AACC 44-15A, flour protein content according to Standard Method AACC 46-10 and Kldal ash content of flour according to standard AACC 08-01, citing the value of wet gluten Standard No. 38 - 11 AACC, flour falling number according to the standard AACC 56-81B, the zeleny test standard No. 61A-56 AACC, is measured. Farinograph test was performed in this study is that the devices are used BRABENDER Germany. By Farinograph test was carried out according to standard AACC 54-10. Extensogeraph is the index tests were carried out according to standard AACC 54-10. A special questionnaire prepared for sensory evaluation of bread with the six judges were trained and they were asked to the terms of compliance with the terms of bread quality was numerically equivalent and then add it to determine the final score was calculated by the following formula:

“$Q = \sum (P.G)/G$”

2.3 Statistical Analysis

The average was compared with each other by Duncan method. Analysis of variance (ANOVA) and comparison of averages was done by SPSS 16.0 software. To compare the Duncan multiple range test at 1% level was used. Software used Spss Version 16.

III. Results

3.1. Results quality of flour

Table 2: Results of the evaluation of flour quality

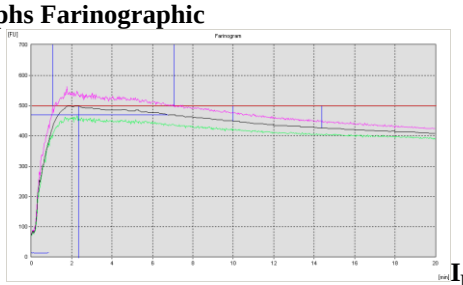
sample	Moisture (%)	Protein (%)	Ash (%)	Fiber (%)	Wet gluten (%)	Gluten index (%)	Falling number	Zeleny
Flour18% mansobian	12.8	10.54	0.809	0.457	27.5	80.55	403	29
Star flour standard	14.2 Max	10 Min	0.85	--	25 Min	80	463 Max	27-35

3.2 Farinograph results of samples

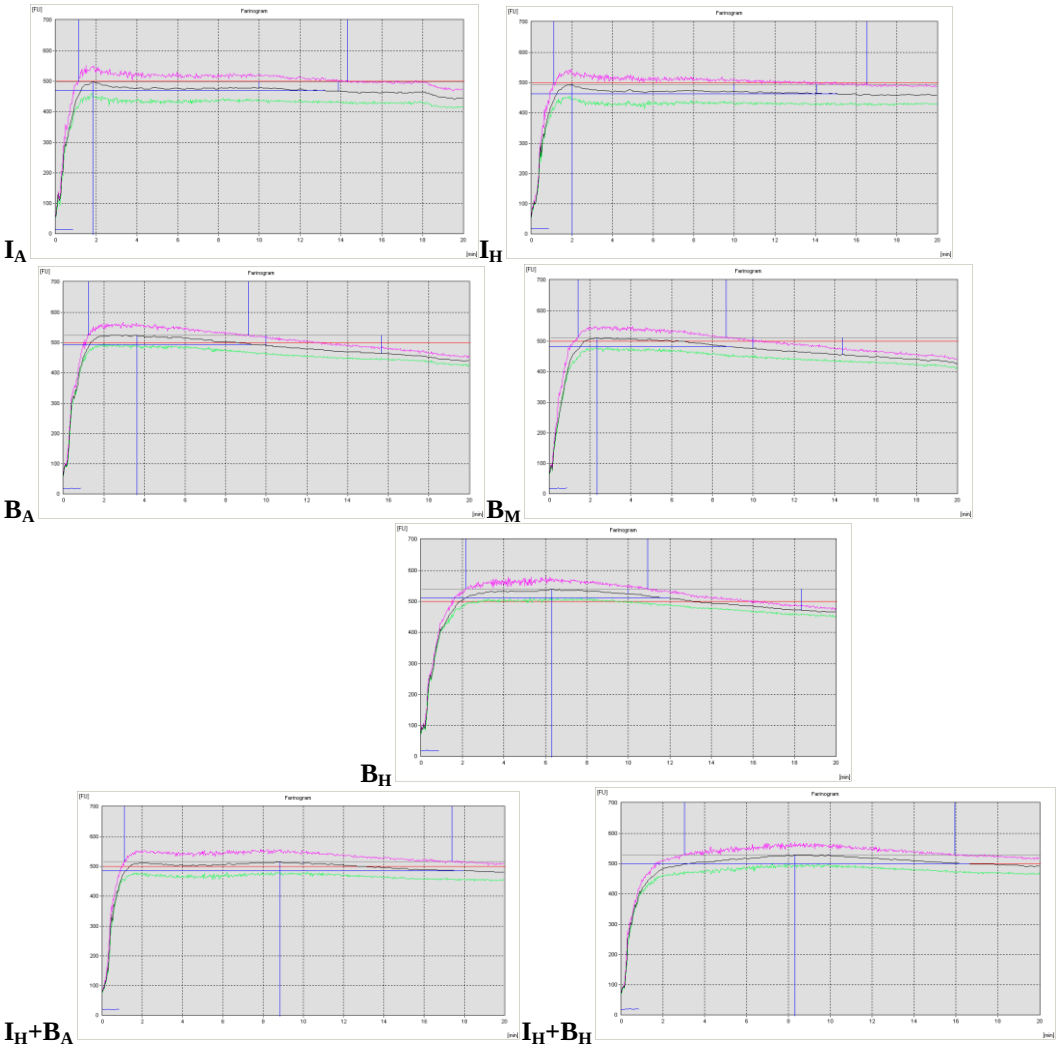
Table 3: Results of Farinograph test

samples	Farinograph parameters and components					
	Water absorption	**Extension time**	**Dough stability**	**Degree of loosening After 10 min**	**Degree of loosening After 12 min**	**Quality index farinograph**
C	60.3±1.64e	2.2±0.03d	5.53±0.03g	60.67±1.41a	83±2.93a	63.0±1.11f
I_M	56.87±2.17g	2.13±0.01d	10.67±0.24d	35.67±0.84b	51.67±1.84c	72.33±2.52ef
I_A	55.6±1.84h	1.93±0.06d	12.47±0.34c	23.67±0.68c	34.67±1.23d	121±3.21c
I_H	54.37±1.68i	1.93±0.08d	16.13±0.21a	21.67±0.52c	30±1.25d	146±3.54b
B_M	62.5±1.84d	2.3±0.04d	7±0.18f	38±0.45b	58.67±2.01c	86.67±2.01de
B_A	63.9±2.11c	3±0.06c	7.5±0.29f	35±0.41b	57.67±2.41c	91.67±2.41d
B_H	68.8±2.41a	7±0.04b	9.3±0.44e	13.67±0.48d	66.67±2.40b	126.7±3.41c
I_HB_A	59.53±2.4f	9.1±0.1a	16.5±0.59a	4±0.02e	-	184.3±4.84a
I_HB_H	64.4±2.51b	8.73±0.07a	13.53±0.41b	3.66±0.08e	-	176.0±4.64a

3.3 Graphs Farinographic



C **I_M**

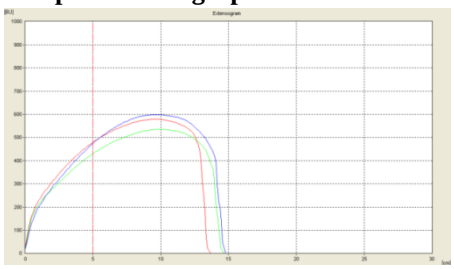


3.4 Extensogeraph results of samples

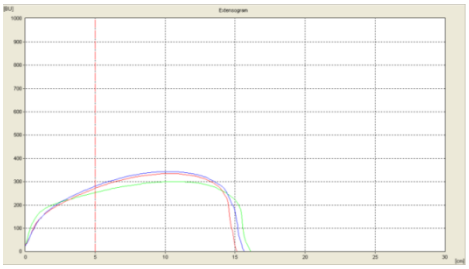
Table 4: Results of Extensogeraph test after 135 min

samples	A(cm^2)	R_{50}(BU)	E(mm)	Ratio Number R_{50}/E (BU/mm)
C	72.00±1.11d	276.0±10.1d	162.6±1.5 a	1.6±0.01c
I_M	111.70±2.51 a	448.0±12.1b	148±3b	3±0.11b
I_A	94.67±1.5 c	423.7±11.7 b	140±1.1 b	3.06±0.1b
I_H	76.67±1.11d	448.7±12.2b	127.7±1.3 c	3.5±0.1 b
B_M	66.67±2.61ef	298.0±10.41 d	141±2 b	2.1±0.09c
B_A	64.00±2.11f	350.0±10c	120±1.5 c	2.9±0.04 b
B_H	71.00±2.1e	368.7±10.2c	126±1 c	2.9±0.03 b
I_HB_A	102.00±3.1 b	563.0±13.6 a	119.5±2 c	4.7±0.12 a
I_HB_H	102.00±3.41b	365.0±13.1a	119.6±3.1c	4.7±0.1 a

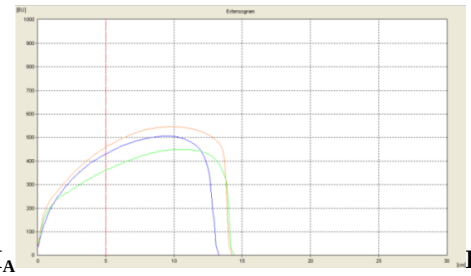
3.5 Graphs Extensographic



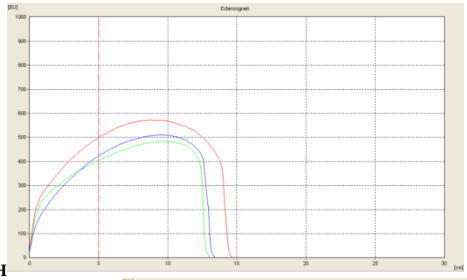
I_M



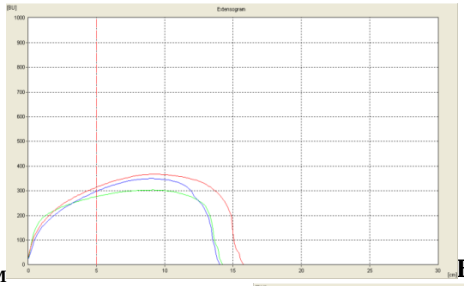
C



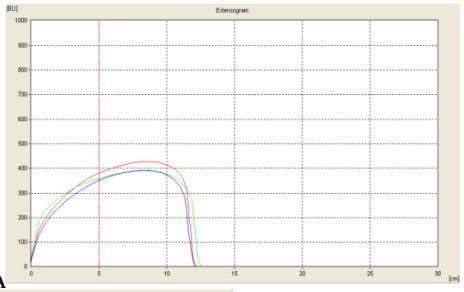
I_A



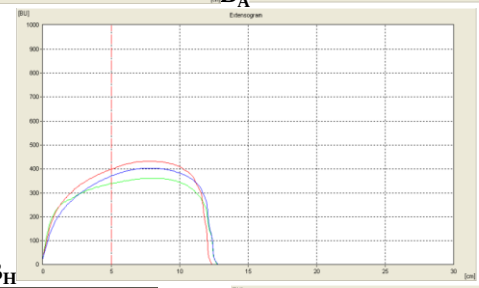
I_H



B_M

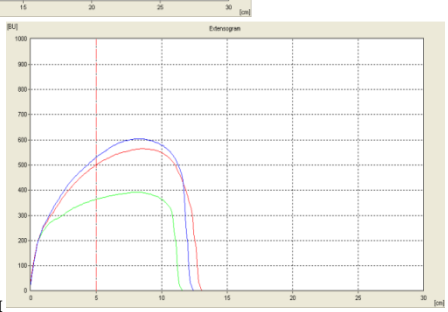


B_A



B_H

I_H+B_A



I_H+B_H

3.6 Sensory evaluation

The results of the comparison of the organoleptic characteristics of bread, bread dough produced from treated and untreated control samples IHBA in the table below.

Table 4: Results of sensory evaluation

Form	8±0.22a	7.5±0.2a
Lower level features and characteristics of bread	3.83±0.11a	3.25±0.12a
Features and properties of bread crust and top level	8±0.11a	6.34±0.14b
Osteoporosis and porosity	9±0.1b	11.85±0.32a
Ability to chew	9±0.21b	11.74±0.31a
The hardness and softness of texture and structure	13.58±0.3a	12.1±0.38b
The smell, the taste of bread	16.1±0.22b	18.85±0.21a
Overall rating	13.55±0.31a	13.99±0.34a

IV. Discussions

4.1 Factors of Farinograph

4.1.1 Water absorption

Due to the abundant hydroxyl groups in the structure of beta-glucan in this matter was strongly humidity with increasing concentration and molecular weight of beta-glucan in dough for water absorption more (Skendi et al., 2009).

Inulin was too wet, but this feature is influenced by the degree of polymerization of the material and its ability to absorb water is lower compared to other hydrocolloids. Inulin also has many hydroxyl groups in its structure, but it will take time to form hydrogen bonds and this distinguishes it from other hydrocolloids and creates a fragile gel network. Inulin also increases the percentage of either gel or powder, water absorption decreases. (Brasil et al., 2011; Morris et al., 2012)

4.1.2 Dough development time

Dough development time increased with increasing beta-glucan. Different fibers of different hydrocolloids on dough development time can be explained by the reaction between the compound and the protein gluten of wheat flour. Composition and structure of Geluten depending on the quality of gluten flour is different. Gliadin and glutenin proteins act as a softenning to get and give help to dissolve or disperse glutenin chains. The amount of gliadin in low-quality flour is much greater.

4.1.3 Farinographic Qualitative factors

Farinographic qualitative factors indicating good quality flour and the dough is obtained. Add all the factors of beta-glucan increased farinograph water absorption is especially. The farinograph properties, flour quality and protein, it also depends.(Rasti et al., 2012) The results are consistent with the results of the investigation so that increasing beta-glucan and inulin farinograph quality factor increases.

4.2 Factors of Extensogeraph

4.2.1 Energy Consumption

Research results indicate that beta-glucan levels were not significant differences between the area under the curve, and increased concentrations of beta-glucan increases the area under the curve (Rasti et al., 2012). Ranged from 135 minutes to increasing the percentage of beta-glucan increased the area under the curve is closer to the controls, but no significant difference compared with the control.

Effect of different percentages of inulin on the amount of Batter energy extensographic test shows that the amount of energy decreases with increasing inulin and dough containing 3% inulin does not control significant difference in terms of energy consumption. (Afshin-pajoh et al., 2012). With the increase of inulin ranged from 135 minutes to reduce the area under the curve is observed.

4.2.2 Tensile Strength

The tensile strength is less than Pulp quality is better. Research results show that the addition of beta-glucan increases the tensile strength. This factor is effective in increasing bread volume is so much higher tensile strength, expansion of gas cells is slower. (Rasti et al., 2012, Skendi et al., 2009; Lazaridou et al., 2007). It ranged from 135 minutes tensile strength increased with the increase of beta-glucan, but there is a difference between BH and BA.

Inulin higher tensile strength and tensile strength of inulin and inulin concentration of 3 and 4% higher than the control levels 1 and 2 percent. (Morris et al., 2012). In terms of tensile strength tests performed on the 135-minute time interval was not significantly different between the different percentages of inulin.

4.2.3 Stretchable

Research results show that the addition of beta-glucan increases ductility. Significant increase in tensile index, tensile ductility and energy required for beta-glucan content increased with increasing water absorption and dough viscosity is related. Add beta-glucan to the dough, the dough affects interactions

between components of the obtained results, the concentrations of 1 and 5/0 percent and as can be seen (Rasti et al., 2012). In line with the results of this study indicate that BM highest ductility with increasing concentration of beta-glucan level in BH and BA stretching mode decreases.

Inulin concentration decreases with increasing traction capabilities. Such as tensile strength, elastic dough containing 3% inulin, which is also the least elasticity decreases. Ability to improve the elasticity of the dough containing 3 and 4% inulin (Morris et al., 2012). With the increase of inulin ranged from 135 minutes to reduce the tension is observed.

4.2.4 Relative Strength Index

Analysis of the effect of different percentages of beta-glucan and inulin on the relative strength index extensographic shows that by increasing the concentration increases the relative strength of these two factors.

4.3 Assess the quality of bread

Add barley flour to wheat flour flat bread produced significant increases in the health benefits and increased dietary fiber improve the properties of porous bread, bread volume, separating the layers, the brain will smell the aroma of bread. Bread porosity due to gas cell stability and improved coagulation occurs.

Although the volume of bread and flour quality depends on the level of beta-glucan beta-glucan, but their properties such as molecular weight and particle size also has an effect on bread volume. The flour quality is low, the addition of beta-glucan improves its properties and the larger the particle size decreases the quality of the resulting bread will be. The molecular weight of beta-glucan in baking and fermentation due to increased mixing time decreases when the incident occurs for low molecular weight beta-glucan. Having a higher molecular weight beta-glucan is a short fermentation time makes this song even flour falling number is also affected. .(Izydorczyk et al., 2008; Anderson et al., 2008; Lazaridou et al., 2007(.Bread crust of bread containing beta-glucan characteristics such as color, shape, color, density and texture of the bread brains fall slightly, which can be due to optimization of sintering conditions.

With increasing concentration beta-glucan brain and crust bread color is darker and denser the bread texture, but flavor and odor is as control bread .(rasti,2012) High molecular weight beta-glucan increased loaf volume, color crumbling darker, denser bread and reduced tissue stiffness is crumbling . Due to the high water absorption of beta-glucan, the steam produced during cooking lesser and thereby helps to denser tissue. The method of preparing a significant impact on the quality of bread. Increased water absorption increases the surface activity of the dough and form a gel network during cooking results in more gas during cooking and is being and loaf volume is better. . Beta-glucan improves gas retention in dough that it is justifiable to increase the viscosity of the batter and the texture of the cooked product will change the appearance of bread and. High levels of beta-glucan reduces gas storage capacity and may lead to a deterioration of the gluten structure. Weaken the elasticity of dough can be related to molecular weight and degree of polymerization of beta-glucan. If beta-glucan bread in a standardized formulation is used to increase the gas cells and that these cells are greater in low molecular weight beta-glucan. . These cells increased with increasing concentrations of beta-glucan to a certain level and then the gas cells are less But with increasing molecular weight of the gas cells are larger, which will be responsible for the decreased steadily crumbling Of course the bread is effective in creating a uniform gas cells. (Skendi et al., 2009)

Studies have shown that inulin in the formation of flavor and crust color during cooking is effective and is responsible for the Maillard reaction. White bread enriched with inulin crumbling soft and had good flavor. With increasing levels of inulin improves crust color Inulin can accelerate the inulin baking is more, the cooking time is shorter. However, since the control bread and bread containing inulin (3%) did not differ significantly. (Brasil et al., 2011)

Inulin HPX improvement in loaf volume of bread also helps to improve the quality of the brain. Even products with good sensory properties are the high percentage of inulin (Filipovic et al., 2010) Showed that the increase in the average chain length of inulin, dough stability increased. Dough water absorption is also affected by inulin. With the addition of inulin, much less water is needed to achieve desired consistency. Consistency of bread dough during the fermentation of inulin chains and the protein content of the flour depends. Some reports indicate the presence of inulin on bread volume is reduced, but not sufficient to change the sensory properties and acceptability bread without prejudice. Invertase enzyme produced by the yeast Saccharomyces cerevisie, which readily hydrolyze inulin chains shorter (Meyer & Peters, 2009).

V. Conclusions

In general it can be said that the BH with IH and IH with BA dough for bread produced synthetically and to determine the best combination of these pulps were also Extensographic tests. The IH combine with BA was selected for the preparation of bread. Although no significant difference was found in Extensographic but the goal was to select the better of these two compounds. Choose this combination would be economically affordable.

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