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The effects of pumpkin seed powder on color indices and sensory properties of Lavash bread produced during storage time

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ABSTRACT

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Cereals have been the most important source of energy for humans. However, due to the relatively low amount of protein in wheat flour, protein-rich products are used. This study was conducted with the aim of investigating the ability of different concentrations of pumpkin seed powder on the color index and organoleptic properties of Lavash bread prepared from it during the storage period. In this research, pumpkin seed powder was used at 4 levels (2.5, 5, 7.5 and 10 gr/kg flour) and in three replications with a completely random design using Design Expert13 software. The results of interaction effects on color indices showed that indices a\* and b\* had significant (p<0.05) during the storage period, so that indices a\* and b\* increased to 11.5 and 7.5, respectively. The results of interaction effects of L\* index showed non-significance during the storage period and its value increased to 90.2 (p>0.05). WI index showed no significance Hue index showed significance. The results of overall acceptance, texture, taste and smell also showed but significance (p<0.05).

## 1-Introduction

Grains have been the most vital section of the human diet throughout history, so that the use of grains is mainly the most vital source of energy. Grains contain 10-20 times more energy than most fruits and vegetables. Studies have shown that the utilization of grains supplies more than 45% of the protein and energy needed daily, and 7% of the total daily fats utilized by each person are also supplied in this way [1]. The most vital grains used are wheat, rice, corn and barley. Wheat and rice together comprise more than 55% of the grain production and are of particular importance due to their direct use in the human diet [1].

The high percentage of starch in wheat flour (60-75%) and whole wheat flour (65-75%) and the relative low amount of protein in them, from this material along with protein-rich products (soybean waste or oilseeds) is used to feed livestock and poultry [2].

Lavash bread is one of the most common and popular breads in Iran. This bread is produced in round or oval form and with a small diameter. The amount of water needed to prepare Lavash bread dough is more than other Iranian breads, and as a result, this bread is easier to chew and utilize. Due to the small diameter of this bread, the surface-to-volume ratio in Lavash bread is very high, as a result, Lavash bread is cooked in a very short time (in a few seconds) and at a very high temperature (300°C to 550°C) and for preparation of Lavash bread requires less amount of gluten than other types of bread [3].

The lack of highly utilized nutrients can increase the risk of contracting a series of diseases such as kwashiorkor, marasmus, ketosis, or cause slow growth, slow wound healing, and increased susceptibility to infections. Also, the lack of low utilization nutrients can also be effective in the development or suffering of mental disability, poor growth, perinatal

complications and degenerative diseases related to aging [4]. Lysine is considered as the first and most vital factor limiting the synthesis of proteins in many common food diets around the world. According to the guidelines published by the World Health Organization and the Food and Agriculture Organization of the United Nations (FAO), the minimum amount of lysine required for adult men that must be provided through the diet is equivalent to 45 mgr./gr of utilized proteins. However, it should be kept in mind that the amount of lysine required by all members of society is not the same [5].

Pumpkin (*Cucurbita maxima*) is one of the 5 species in the Cucurbitaceae family. This plant is generally cultivated for the purpose of harvesting and using pulp, flower and seed. This plant is native to South America. This seed is rich in proteins, unsaturated fatty acids, fibers, vitamins and antioxidants such as carotenoids and tocopherols. In addition, the seeds of this plant are rich in minerals, including zinc (113gr/grμ), potassium (5790mgr./gr), magnesium (5690gr/grμ), manganese (3.49gr/μgr), selenium (29.1gr/μgr), copper (15.4gr/μgr) and molybdenum (0.81gr/μgr)[6,7]. In research, the enrichment of flour distributed in the bakeries of Shahinshahr, Isfahan was discussed. In this research, bivalent iron sulfate with a ratio of 150 mgr/kg was used for flour enrichment. The results of the study showed that despite the lack of significant changes in blood cell indicators in the time frame before and after the test, the percentage of people with ferritin lower than 18ngr/ml blood decreased from 43.6 percent in the period before the consumption of enriched bread to 27.4 percent in the period after the consumption of enriched bread [8]. Mashaikh et al. (2006) investigated the effect of enriching Tafton bread using defatted soybean flour. The results of this research showed that wheat flour enriched with fat-free soybean flour changed the sensory characteristics of bread (appearance, taste, aroma, smell,

crispiness and overall acceptance. In addition, enrichment caused a significant increase in the amount of protein and minerals in breads made from enriched flour compared to breads made from wheat flour. Also, the sensory evaluation conducted by 213 untrained evaluators showed that the use of 3 to 7% of defatted soybean flour for enriching wheat flour had the best results [9].

Mahdavi Roshan et al. (2016) investigated the effects of enriching flour with iron and folic acid in research in Iran. The results of this research showed that the final amount of iron in enriched flour in the country is around 80-85 mgr/gr. The researches indicated that due to the different amount of iron consumption among different people of the country who have different economic levels, the use of iron-enriched flour at the above-mentioned level can cause risks for some members of the society [10].

Apostol et al. (2018) investigated the feasibility of using pumpkin seed powder for flour enrichment. The results obtained by this group indicated that the pumpkin seed powder used had 42.75% protein, 12.28% lipid, 37.4% carbohydrates and 26.64% edible fiber, and the used powder contained high amounts of potassium, magnesium, iron and copper. Also, this substance is a rich source of essential amino acids such as valine, histidine, isoleucine, leucine, threonine and methionine. Finally, researchers concluded that pumpkin seed powder is considered as an excellent source for flour enrichment due to its high nutritional value [11].

Bohlal et al. (2019) investigated the health benefits and physicochemical, nutritional, and technological characteristics of flour enriched with lentils. In this research, 6 different levels of flour, a mixture of wheat flour and lentil powder were used. The results showed that the nutritional parameters such as the amount of ash, protein, fat and energy index increased as a result of flour enrichment compared to non-

enriched flour. Carbohydrate content in all enriched samples was lower than control flour. Clarity, whiteness index and gluten strength values decreased with increasing amount of lentil powder used. Also, the results showed that the enrichment of flour with the used treatments decreased the water absorption power of the dough. Finally, the conclusion of this research indicated that the enrichment of flour up to 20% with lentil powder can improve the nutritional quality and the health consequences of its consumption on humans [12]. Due to the fact that no research has been done on the enrichment of wheat flour with pumpkin seed powder and its characteristics have not been investigated, therefore, the purpose of this research is a new enrichment in Lavash bread and the selection of pumpkin seed powder due to its high nutrients and salts.

## 2- Materials and methods

### 2-1- Materials

The pumpkin was bought from the Tehran market. All chemicals used were purchased from Merck, Germany. Taking pictures was done with a Canon model color scanner. Sensory test was done by using 9 trained evaluators at Shabab Flour Factory, Ilam.

### 2-2- work method

In order to prepare the samples, the flour produced by Shirvan Flour Company, Cherdavel, Ilam, was used with a mixing percentage of 50% strong wheat and 50% weak wheat. The produced flour was quarantined for 48 hours. Then, to prepare complete pumpkin seed powder, first, the seed was separated from the pumpkin and dried in a dryer with hot air flow until it reached 9% humidity. To prepare complete powder, dried samples were ground and passed through 40 mesh. Pumpkin seed powder was added to Lavash flour in the amount of (2.5, 5, 7.5 and 10 grams per kilogram of flour). Flour without the addition of pumpkin seed powder was

considered as a control sample. Then according to Table 1, the treatments were prepared.

Dough mixing time, water temperature and the amount of salt used, as well as dough, baking time and oven temperature were considered the same in all samples.

### 2-3- Sensory tests (color, smell, taste, structure and general acceptance)

9 trained evaluators were used to perform this test. Each of the judges individually evaluated the types of bread samples prepared with 5 repetitions in terms of color, smell, taste, structure and overall acceptability. The score obtained for each parameter for each bread sample was reported from 1 to 10. In this scale, 1 represents the lowest and 10 represents the highest value [13].

### 2-4- Measuring color changes

In order to check the color characteristics, the film samples were scanned with a Canon color scanner (Canon, Cano Scan, LiDE 120 Scanner) with DPI600 accuracy. All photos were saved in JPEG format and high quality, and then converted to  $b^*$ ,  $a^*$  and  $L^*$  space by the Image j 1.4g software using the color-space converter, which is called a program add-on [14].

#### 2-4-1- LAB color space

This color space is made up of three components.  $L^*$  indicates the brightness of the image, which changes between 0 equivalent to black and 100 full reflections of light. The values of the component  $a^*$  are unlimited and positive values are equivalent to red color and negative values are equivalent to green color.  $b^*$  values are unlimited and positive values are equivalent to yellow color and negative values are equivalent to blue color [14].

#### 2-4-2- Image processing

Other parameters obtained from color indices  $b^*$ ,  $a^*$  and  $L^*$  include saturation index (SI), hue angle (Hue) and brightness index (WI) which are obtained from the following formulas [14].

$$SI = \sqrt{a^{*2} + b^{*2}}$$

$$\text{Hue} = \arctan\left(\frac{b^*}{a^*}\right)$$

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

### 2-5- Statistical analysis

All the experiments were done in three repetitions ( $n=3$ ) with completely random sampling according to Table 1. In this design, the main effects and their analysis of variance were investigated, as well as graphs were drawn with Design Expert<sub>13</sub> software.

Table1. Treatments of produce Lavash bread

Treatment	A: pumpkin Seed (gr/kg flour)	B: storage time (day)
1	5	3.5
2	5	0
3	2.5	5.25
4	7.5	5.25
5	10	3.5
6	5	3.5
7	5	7
8	5	3.5
9	2.5	1.75

### 3-Results and discussion

#### 3-1- The interaction effects of variables on a\*, b\* and L\* indices during the storage period

Figure 1 shows the diagram of interaction effects of variables on a\*, b\* and L\* index during the storage period. The results of this diagram show the significance of the interaction effects of the variables on the indicators during the storage period. In

research on the effect of using pumpkin powder and its effect on the structure of the produced bread, Wahyono et al. reported similar results. The research results of this group showed a significant increase in the amount of yellowness index as a result of increasing the use of higher amounts of the enriching powder (Wahyono et al., 2018). Considering the presence of carotenoids such as lutein, lycopene and beta-carotene in pumpkin seeds and that these substances are natural pigments, the results obtained in this research were predictable [15].

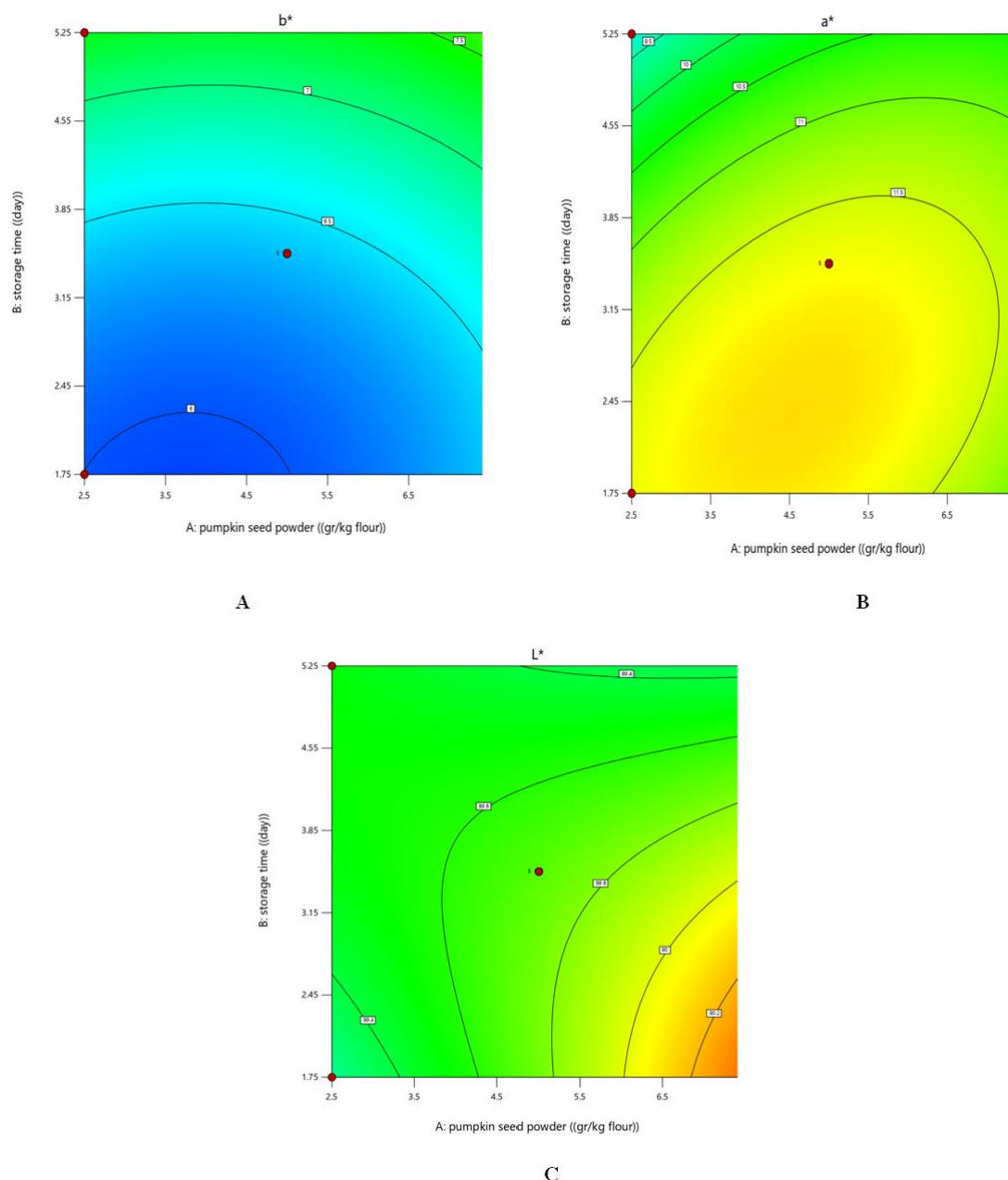


Fig1: graph of interaction effect on the  $a^*$ ,  $b^*$  and  $L^*$  in storage

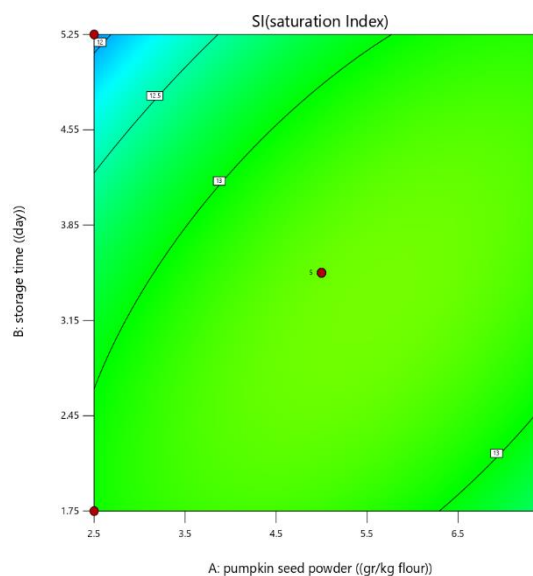
### 2-3- Interaction effects of variables on saturation index (SI) during the storage period

Figure 2 shows the interaction effects of variables on the saturation index (SI) during the storage period. The results of this graph show the non-significance of the interaction influence of the variables on the saturation index (SI) during the storage period. Based on the results of the above graph, increasing the use of pumpkin seed powder has caused

a slight decrease in the saturation index of bread color. On the other hand, increasing the storage period has caused breads to show a decrease in color saturation. The results obtained in this research are consistent with the research conducted by Solvita et al. on the quality parameters of bread enriched with pumpkin powder. The results of this research showed that the use of pumpkin powder during the storage period increased the color saturation index

[17]. This contradiction can be justified due to the difference of pigments in pumpkin and its seeds. It can be argued that the use of pumpkin seed powder (with a light green color) has caused the saturation of the bread color (yellowish white) to decrease. On the

one hand, increasing the storage period through the reduction of humidity and on the other hand, the processes involved in the staleness of the bread have caused the saturation of the color of the bread to decrease.



### 3-3- The interaction effects of variables on the whiteness index (WI) during storage

Figure 3 shows the diagram of interaction effects of variables on whiteness index during the bread storage period. The results of this graph show the non-significance of the interaction effect of the variables on the whiteness index during the bread storage period. According to the graph, increasing the use of pumpkin seed powder has increased the whiteness index. On the other hand, increasing the storage period of the produced bread has caused a decrease in the whiteness index in the product. As a result, these two factors have acted in the opposite

way and have caused a significant impact in this field to be not visible. The results of this research were in contradiction with the results of Solvita et al. They showed that increasing the use of pumpkin powder caused a significant decrease in the whiteness index in bread during the storage period [17]. According to the difference in the pigments in pumpkin and its seeds, this contradiction can be justified and it can be concluded that increasing the storage time of bread by reducing the humidity causes a decrease in the whiteness index and on the other hand, increasing the use of pumpkin seed powder due to the existing pigments and their interaction with the pigments in the flour, has increased the whiteness index of the bread.

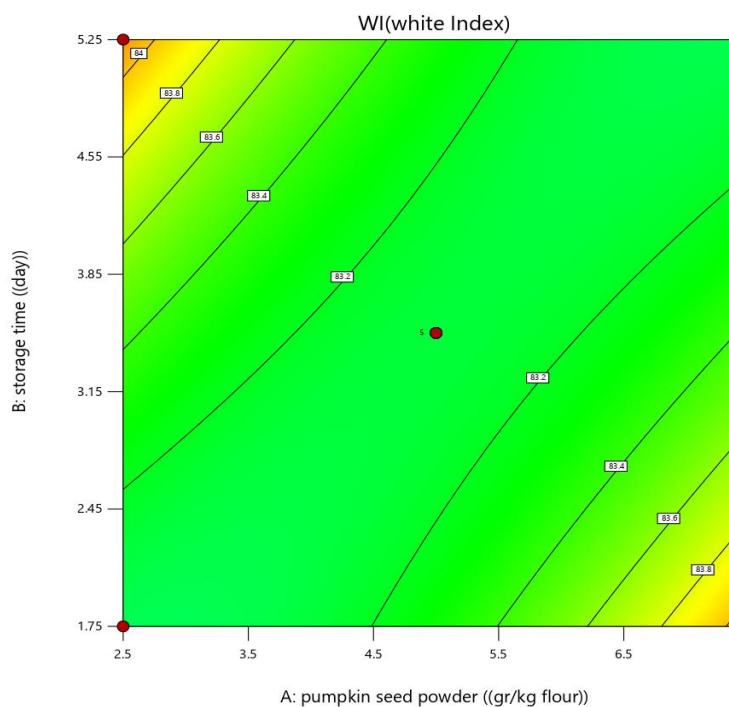


Fig3: graph of interaction effect on the WI in storage

### 3-4- The interaction effects of variables on Hue during storage

Figure 4 shows the diagram of interaction effects of variables on Hue during bread storage. The results of this diagram show the significance of the interaction influence of variables on Hue during the bread storage period. As can be seen in the above diagram, increasing the use of pumpkin seed powder has caused a change in the hue of the bread. On the other hand, the increase in the storage period, as well as the use of enriching powder, has caused a great change in the color of the bread. Our results

are consistent with those obtained by Rosillo et al. Rosillo et al. showed that the use of pumpkin powder to enrich bread resulted in a significant increase in moisture content during the storage period of the prepared bread [18]. Increasing the duration of storage through reducing humidity can cause significant changes in the amount of moisture. On the other hand, due to the difference between the pigments in pumpkin seeds and the pigments in wheat flour, increasing the amount of pumpkin seed powder can also cause a significant change in the color of bread.



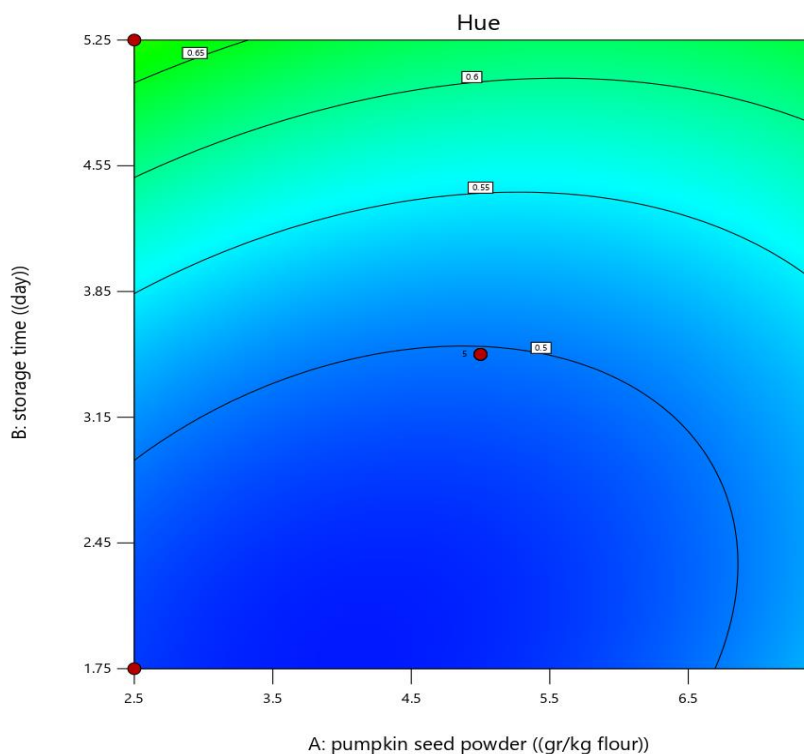


Fig4: graph of interaction effect on the Hue in storage

### 3-5- Interaction effects of variables on overall acceptance during storage period

Figure 5 shows the interaction effects of the variables on the overall acceptance during the storage period of the prepared bread. The results of this graph show the significance of the interaction influence of variables on overall acceptance during the bread storage period. Based on these results, the highest overall acceptance rate of bread produced using 3.5 to 5.5 grams of pumpkin seed powder per kilogram of flour and in the first days of bread baking was obtained. Also, increasing the duration of

storage has caused a decrease in the acceptability of produced bread. Nevertheless, the lowest rate of decrease in acceptability over time is determined between 3.5 and 5.5 grams of pumpkin seed powder per kilogram. These results were in accordance with the results obtained by Dabash et al. The results of Dabash et al. showed that the balanced use of pumpkin seed powder increased the overall acceptance rate of the produced bread. However, the use of high amounts of this substance to enrich bread caused a decrease in the overall acceptability of the resulting bread [17].

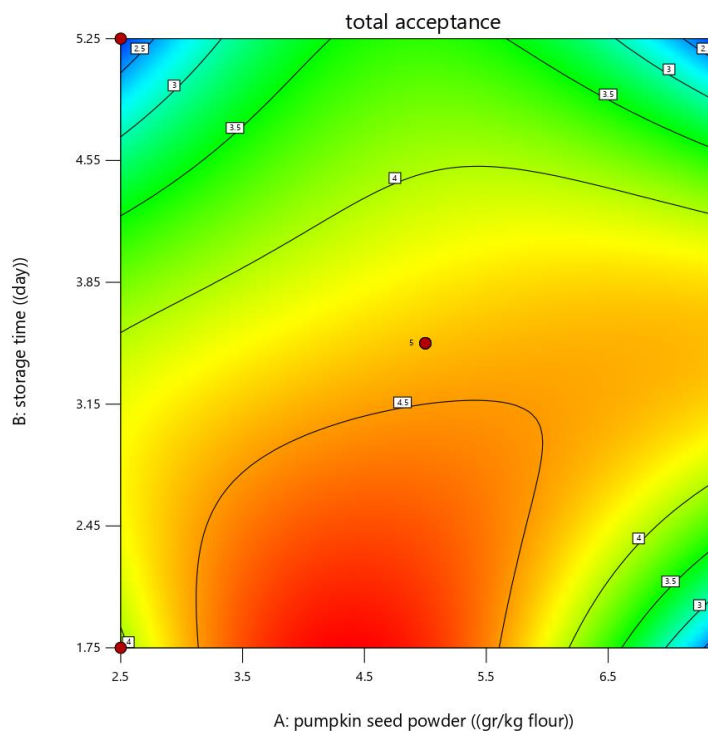


Fig5: graph of interaction effect on the total acceptance in storage

### 6-3- Interaction effects of variables on tissue during storage period

Figure 6 shows the interaction effects of the variables on the texture during the storage period of the prepared bread. The results of this diagram show the significance of the interaction effect of variables on texture during the bread storage period. The use of pumpkin seed powder at the rate of 3.5 to 4.5 grams per kilogram can result in the best texture in the bread produced on the first

day after baking. In addition, by increasing the amount of pumpkin seed powder used, the texture quality of the produced bread is preserved in a longer period. Milovanich et al. reported the best bread texture produced in breads prepared from 10% pumpkin seed powder. Due to the fact that increasing the amount of enrichment in our research has improved the bread structure during the post-production period, the results of Milovanovich et al. can be considered consistent with the results of this research [19].

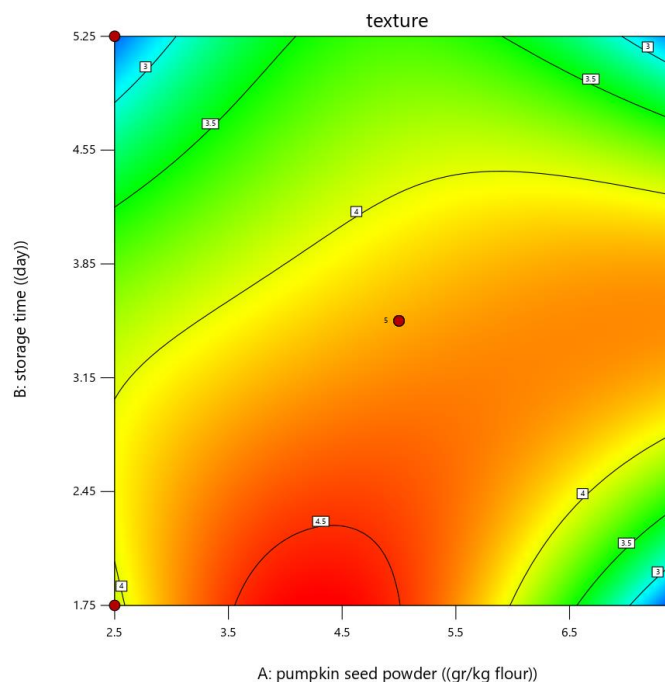


Fig6: graph of interaction effect on the texture in storage

### 3-7- The interaction effects of variables on taste during storage period

Figure 7 shows the interaction effects of the variables on the taste during the storage period of the prepared bread. The results of this graph show the significance of the interaction effect of variables on the taste during the bread storage period. Mansour et al., in a study that investigated the effects of using pumpkin and canola proteins on the quality of bread, reported no significant difference between breads enriched with 18

to 22% pumpkin protein concentrate [20]. These findings are not consistent with our findings. This inconsistency can be due to the difference in the composition of ingredients affecting the taste in protein concentrate and pumpkin seed powder. Nevertheless, Mirjana et al showed that the use of pumpkin seed powder compared to quinoa and black wheat had a greater effect on the taste of the produced bread [19]. These results agree with the results obtained in this research.

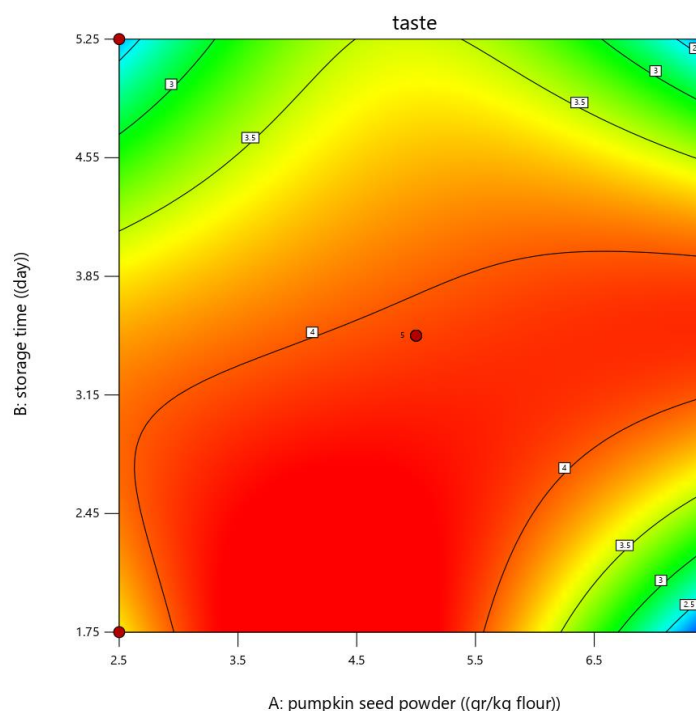


Fig7: graph of interaction effect on the taste in storage

### 3-8- Interaction effects of variables on smell during the storage period

Figure 8 shows the interaction effects of variables on the smell during the storage period on the produced bread. The results of this graph show the significance of the interaction effect of variables on the smell during the storage period of bread. Mirjana et al reported similar results in the research

on the effect of using quinoa, black wheat and pumpkin seed powder for flour enrichment. The results of this group showed that the use of pumpkin powder significantly improved the aroma of the produced bread [19]. Considering the presence of aromatic compounds in pumpkin and its seeds, it can be concluded that the use of this substance to enrich bread can improve the aroma of the product.

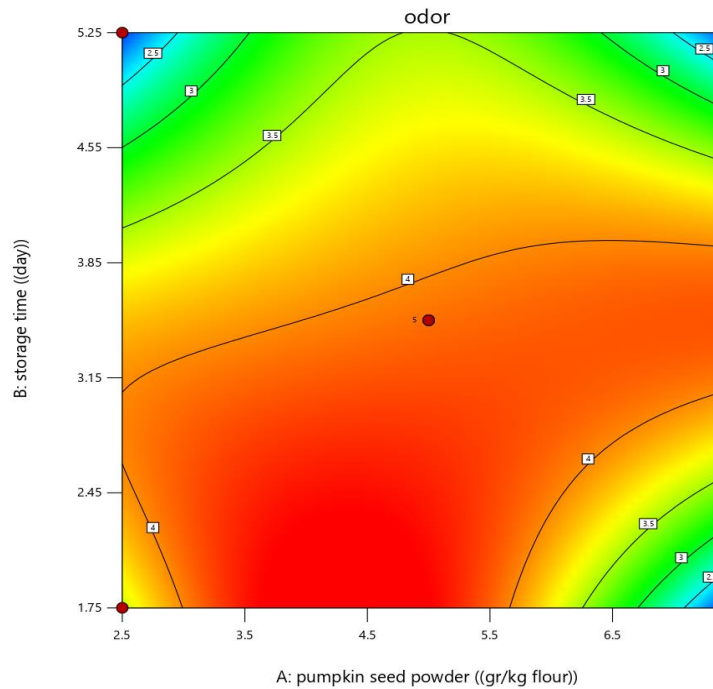


Fig8: graph of interaction effect on the odor in storage

#### 4 – Conclusion

Investigations showed that the use of pumpkin seed powder significantly improved most of the physical and chemical quality parameters of flour and enriched bread. Also, in this research, the sensory properties of the bread prepared during the storage period were also examined. The results obtained in this field also showed the overall improvement of the enriched bread properties compared to the control sample. As a result, it can be suggested that the use of pumpkin seed powder as a relatively cheap and efficient source can be used in the production of bread with nutritional value and superior physical, chemical and sensory properties.

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تأثیرات پودر تخم کدو تنبل بر شاخص‌های رنگی و خواص حسی نان لواش تولید شده در طول زمان نگهداری

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اطلاعات مقاله	چکیده
تاریخ های مقاله :	غلات مهمترین منبع تامین انرژی برای بشر می باشد. با این وجود به دلیل پایین بودن نسبی میزان پروتئین موجود در آرد گندم از محصولات با پروتئین غنی شده استفاده می شود. این مطالعه با هدف بررسی قابلیت غلظت‌های مختلف پودر تخم کدو تنبل بر شاخص‌های رنگی و خواص ارگانولپتیک نان لواش تهیه شده از آن در طی دوره نگهداری انجام گرفت. در این پژوهش از پودر تخم کدو تنبل در ۴ سطح (۲/۵، ۵، ۷/۵ و ۱۰ gr/kg) و در سه تکرار با طرح کاملاً تصادفی با استفاده از نرم افزار Design Expert 13 انجام شد. نتایج اثرات متقابل بر شاخص‌های رنگی نشان داد شاخص‌های $a^*$ و $b^*$ نتایج معنی داری ( $p < 0/05$ ) طی دوره انبارمانی داشتند بطوریکه شاخص $a^*$ و $b^*$ به ترتیب روند افزایشی به ۱۱/۵ و ۷/۵ مشاهده شد. نتایج اثرات متقابل شاخص $L^*$ عدم معنی دار بودن را در طول دوره انبارمانی نشان داد و مقدار آن به ۹۰/۲ افزایش یافت ( $p > 0/05$ ). شاخص‌های WI عدم معنی دار و شاخص Hue معنی دار بود. نتایج پذیرش کلی، بافت، مزه و بو نیز معنی دار بودن ( $p < 0/05$ ) را نشان داد. نتایج کلی نشان داد استفاده از پودر تخم کدو تنبل به عنوان یک منبع نسبتاً ارزان و کارآمد می تواند برای تولید نان با ارزش غذایی و ویژگی‌های فیزیکوشیمیایی مطلوب مورد استفاده قرار گیرد.
کلمات کلیدی: آرد، پودر تخم کدو تنبل، شاخص رنگی، دوره انبارمانی	
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