

PAPER • OPEN ACCESS

The Influence of Fenugreek Seeds Gum on Quality of Pan Bread During Storage

To cite this article: Bushra B. Al-Shammari *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1060** 012062

View the [article online](#) for updates and enhancements.

You may also like

- [The impact of cold atmospheric pressure plasma jet on seed germination and seedlings growth of fenugreek \(*Trigonella foenum-graecum*\)](#)
Sahar A FADHLALMAWLA, Abdel-Aleam H MOHAMED, Jamal Q M ALMARASHI et al.
- [Electrical, characterization and functional properties of extract gum \(*Trigonella Foenum graecum* L. \) from Fenugreek seeds.](#)
B B Al-Shammari, R M Al-Ali and A A Al-Sahi
- [Effect of Phenylalanine and Naphthalene Acetic Acid on Growth, Yield and Antioxidant Activity of Fenugreek *Trigonella foenum-graecum*](#)
M H Al-Duraid, K A Al-Taey and Ali H J Al-Kikhani



The Electrochemical Society
Advancing solid state & electrochemical science & technology

242nd ECS Meeting

Oct 9 – 13, 2022 • Atlanta, GA, US

Early hotel & registration pricing ends September 12

Presenting more than 2,400 technical abstracts in 50 symposia

The meeting for industry & researchers in

BATTERIES
ENERGY TECHNOLOGY
SENSORS AND MORE!



ECS Plenary Lecture featuring M. Stanley Whittingham,
Binghamton University
Nobel Laureate –
2019 Nobel Prize in Chemistry



The Influence of Fenugreek Seeds Gum on Quality of Pan Bread During Storage

Bushra B. Al-Shammari¹, Rawdhah M. Al-Ali and Ali A. Al-Sahi

Department of Food Sciences, College of Agriculture, University of Basrah, Iraq.

¹ Email: bushra.jerad@uobasrah.edu.iq

Abstract. This search was conducted to extract the gum from fenugreek seed and studying the effects on bread staling, and its application a gum in controlling bread staling by replacing 0.5,0.75,1.1.5 and 2% wheat flour . Bread staling was measured under different storage conditions , loaves were stored in polyethylene bag for 1,5and 7 days and temperature 25-30,4 and 18- C°, two techniques were used to study bread staling such Differential Scanning Calorimetry and Scanning Electron Microscopic,the moisture content in the crumb and the crust range between 1.5 – 2.66 , 1.99 – 3% and 1.9 – 3.88% and 0.45 – 0.27 , 0.3 – 0.21,1.90 - 1.9 % at concentrations 1.5 and 2% , the result of Swelling Power and volume of sediment showed range between 7 – 9 , 8 – 9.66 ,4 – 5.88% and 41 – 45.44 ,46 – 50 ,47 – 50.88 ml respectively, the test of pH showed between 6.2 – 6 ,6.4 – 6.48 and 6.1 – 6.4 respectively, two methods were used to determine bread staling ,the values of Electrical conductivity and Turbidity showed range between 3 – 4.11 , 4 – 5 , 3.57 – 4.5 cm /mm respectively and 11 – 13.99 , 19 – 23.01 ,29.55 – 34.44 NTU respectively, the results of DSC showed that the highest enthalpy of retrogradation showed range between 57.98 - 75.69 , 41.86 -54.12 respectively and 27.67 - 38.91 J/g respectively was found in control sample compared to bread containing Fenugreek seeds gum 26.24 – 28.14 , 26.78 - 29.41 and 13.30 -15.90 J/g respectively after 1and 7 days of storage at different temperature storage. ,The microstructure of the bread was tested by Scanning Electron Microscopic, the result indicated that bread containing Fenugreek seeds gum had lower staling compared to control sample due to able to retain moisture in the bread crumb. Therefore, the present research, gum addition reduces retrogradation of starch and improved the microstructure crumb during storage.

Keywords. Fenugreek, Pan Bread, Bread staling, Food.

1. Introduction

Bread is an important staple food in both non- developing countries and developing countries .It is produced commercially from wheat flour with other materials ,which are yeast ,salt , fat and water [1] , Although the bread is consumed daily after baking , the modern lifestyle showed the need to produce bread for a long period of freshness and in this regard a few types of additives appeared aimed at improving the quality of fresh bread and delaying the staling of the bread, as bread a product with a short storage life and is more putrefaction compared to other baked products [2,3] . Bread loses its freshness quickly during the first storage due to changes in the physical and chemical properties , which leads to a decrease in the smoothness of the crumb during storage [4]. staling bread phenomenon is defined as the physical and chemical changes that occur in baked products after



baking , making the products less accessible to the consumer , retrogradation of starch is the important factor that causes the hardness of the crumb (koksel,2009). Several studies have also shown that retrogradation of starch is not the only factor responsible for the staling of the crumb , as water plays a role in the staling of bread [5].

Hydrocolloids have been introduced as additives in the structure of the bread ,as they work to modify and improve the rheological and technical properties of the dough by controlling the quality of the final products , extending their storage life ,preserving their moisture content and delaying staling [6,7]. Several methods were used to measure bread staling based on including thermal analyzes such Differential Scanning Calorimetry [8] .

The research aimed to determine the effect addition fenugreek gum on the staling bread at different storage temperature .

2. Material and Methods

2.1. The Fenugreek Seeds were Purchased From Market Local of Basrah City

The seeds were grinding using a coffee grinder. Wheat flour (70% extraction) was obtained from Farahidi mill / General company for grain processing / Basrah , other materials were purchased from market local such a sugar, dry yeast , fat and salt . All the other solvent reagents and chemical used were analytical grade.

2.2. Gum Extraction

Mustard seeds gum was extracted according to the method described by [9]. A 100g quantity of The mustard powder was added to distilled water within a ratio (1:10 w/v), The mixture was mixed using shaking for 4h at 40 C°. The gum was filtered through muslin to remove the insoluble solids . The extract was precipitated by using ethanol (99%). gum was dried in oven at temperature 40-45 C° and stored in airtight container.

2.3. Mixing

Fenugreek seeds gum was added at different levels between 0.5 -2% to wheat flour to produce pan bread ,using wheat flour with 0% fenugreek seeds gum was considered as control for all analyses.

2.4. Baking Processing

Bread was prepared from flour by using straight dough method no .10-09 in method described in [10].

Table 1. Formulation of bread.

The Ingredients	A mount in grams
Wheat flour	100
Fenugreek seeds gum	0.5 - 2 %
Water	60 %
Sugar	6
Fat	1
Dry yeast	3
Salt	1.5

The Ingredients were mixed. The yeast was prepared with water and added in dough mixer by keeping the mixer at 1 speed, The quantity of water used for the control and FG bread was based on the farinograph absorption , The premixing was done after addition fat 1 and salt 1.5 and water was added , after mixing , The dough was placed in proofing cabinet at 30-32 C and 80-85% relative humidity for 45 min. after punching the dough was divided and again proofed for 10 min under the same conditions, Finally the dough balls were sheeted and placed in proofing cabinet for final proofing for 60 min under the same conditions. The loaves were baked for 45 min at 180 C. after baking the loaves were cooled at room temperature.

2.5. Storage

After baking ,bread placed in plastic bags and storage at 25-30 ,4 and 18-C° for 1 ,5 and 7 days.

2.6. Staling Tests

2.6.1. *The Percentage of Moisture of The Crumb and Crust were Determined According to Method in [10].*

2.6.2. Swelling Power

The method mentioned was followed in [11] estimating the Swelling power and it was calculated through the following equation.

$$\frac{C-B}{C} \times 100 \quad (1)$$

C: weight of the sample before hydration, B: weight of the sample after hydration0

2.6.3. Sediment of Volume

Sediment of volume of bread was determined according to method described by[12].through that 10 g of crumb in a 100 ml graduated cylinder with the addition of 75 ml distilled water, the contents of the cylinder were mixed well for 15 min , after which a full hour was left until all the pulp contents were deposited and the size of the pulp sediment was calculated in units of ml.

2.6.4. Determination of PH

pH was measured according the method [10].

2.6.5. Electrical conductivity

Electrical conductivity was carried out in the central laboratory of the department of soil and water resources / college of agriculture university of basrah , 10 g of crumb in a 100 ml graduated cylinder with the addition of 75 ml distilled water, the contents of the cylinder were mixed well for 15 min , after an hour the filtrate was discharged in to a cylinder to submerge the poles of the device in it to record the reading.

2.6.6. Turbidity

The Turbidity of the filtrate was determined according to method described by [12]. 10 g of crumb in a 100 ml graduated cylinder with the addition of 75 ml distilled water, the contents of the cylinder were mixed well for 15 min ,ml of the filtrate is placed in the tube of the device located in the central laboratory of the soil department after it is closed tightly to record the reading.

2.7. Techiques Used to Follow the Staling of Bread

2.7.1. Differential Scanning Calorimetry (DSC)

The possible changes were followed during the bread storage at different temperature 25-30 , 4 and 18- C° using thermal analysis for the polymer research center /al-basra university after one day and 7 days of stroage , 10 mg of bread powder in the device with a serial temperature raised from the laboratory temperature 20 C down to 350 C and a heating rate 20C/ min

2.7.2. Scanning Electron Microscopic (SEM)

Analysis of the crumb composition was carried out from the center of each of the lab slices of bread at different temperatures .a fter1 and 7 days of storage .It was placed in a plastic tube and closed and then immersed in liquid nitrogen for 3 minutes and inserted in a vacuum oven.It was left for the next day to ensure that the sample was completely dry. It was cut with a sharp blade and A dimension of 1*1*1 mm and placed on a metal stand after fixing it with a special carton adhesive . the examination was done without coating by the Scanning electron microscope device of the college of

pharmacy/Basra university with a voltage e of 1 kv and a magnification of 15000x-1000x according to the method used

2.8. Statistical Analysis

All samples were evaluated by ten arbitrators in the Food Science Department / Agriculture college / Basrah University. the physical data and chemical analysis were made triplicate. These data were analyzed using SPSS2012, analysis of variance (Anova). Comparative analysis between parameters were carried out by L.S.D. With probability (P < 0.05) .

3. Results and Discussion

3.1. The moisture Content in Crumb and Crust of Bread

From these results in figure (1) , it could be noticed that the highest moisture content in crumb bread containing fenugreek gum range between 1.5 – 2.66 , 1.99 – 3 and 1.9 – 3.88% compared with control 0.95 -1.12% at different temperature storage ,while the decrease moisture content 0.45 – 0.27 , 0.3 – 0.21, 1.90 -1.9 % at concentrations 1.5 and 2% after 7 day of storage compared with control 0.95 – 0.59 and 1- 0.91 and 1.12 -1% . The difference may be attributed to putry of Arabic gum and Acacia . As for the moisture content in the crust ,It is noticed from figure (2) the decrease moisture content in crust of bread containing gum while the increase moisture content in control sample 0.50 ,0.40 and 0.30% , the result showed the differents between crumb and crust because the gum responsible for retention of moisture in crumb bread.

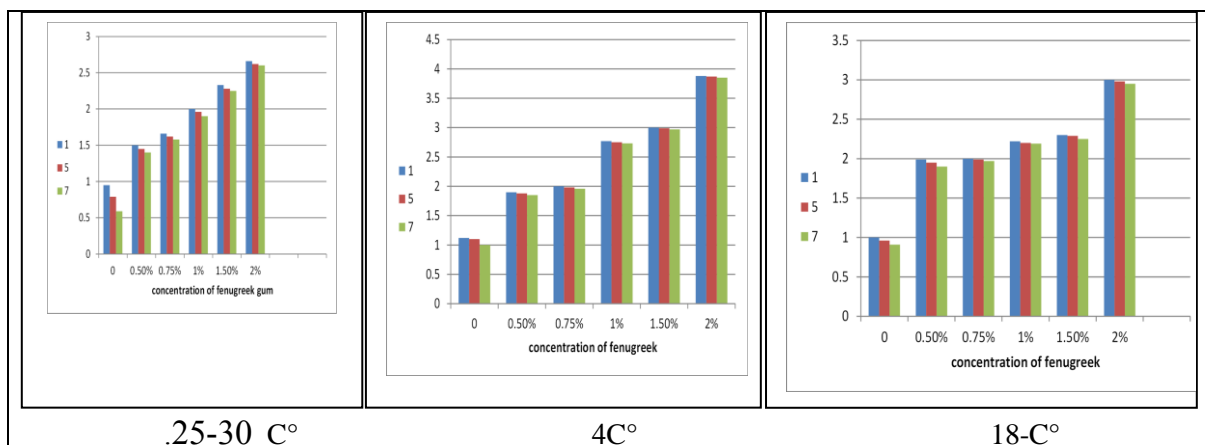


Figure 1. Effect of different temperatures on moisture content of the crumb.

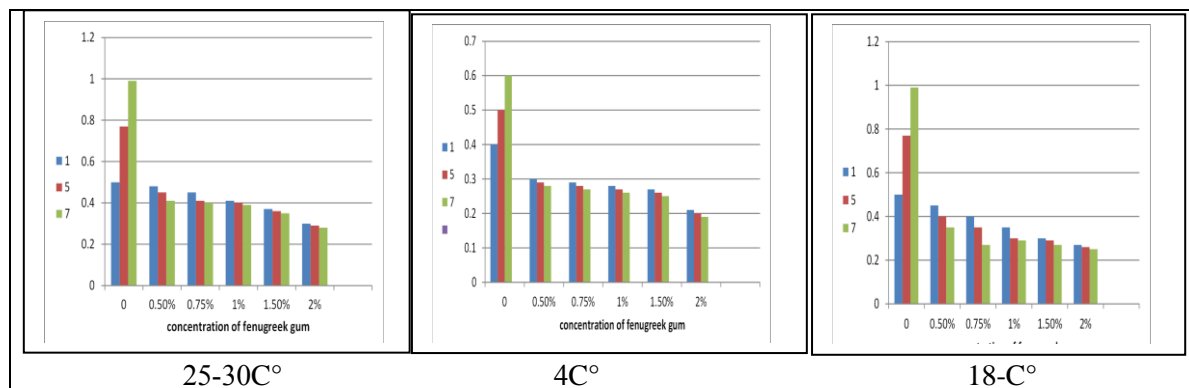


Figure 2. Effect of different temperatures on moisture content of crust.

3.2. Effect of Fenugreek Gum Addition on Swelling Power , Sediment of Volume, pH of Crumb

The results of figure 3,4 showed that the highest Swelling power and sediment of volume in bread containing gum range between 7 – 9 , 8 – 9.66 , 4 – 5.88% and 41 – 45.44 ,46 – 50 ,47 – 50.88 ml respectively compared the control ,while the decrease after 7 days of storage , figure 5 showed the Ph increase during bread storage range between 6.2 – 6 ,6.4 – 6.48 and 6.1 – 6.4 respectively, the lower pH was observed for bread containing gum.

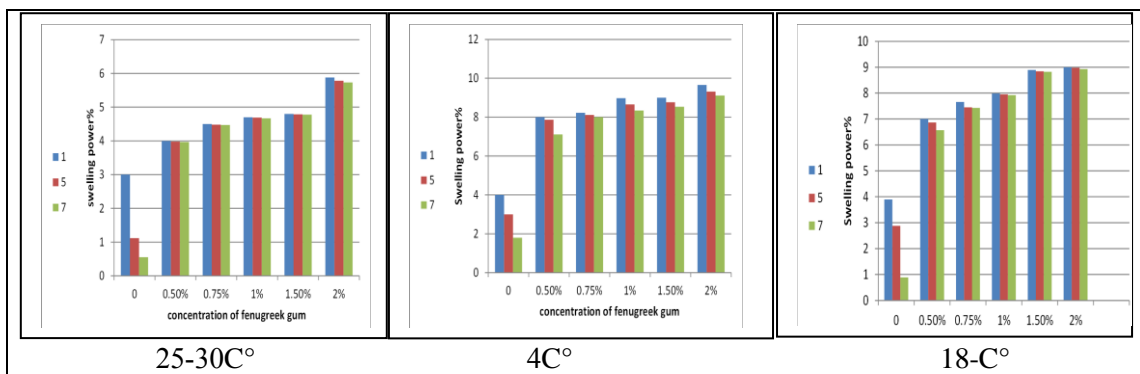


Figure 3. Effect of different temperatures on swelling power.

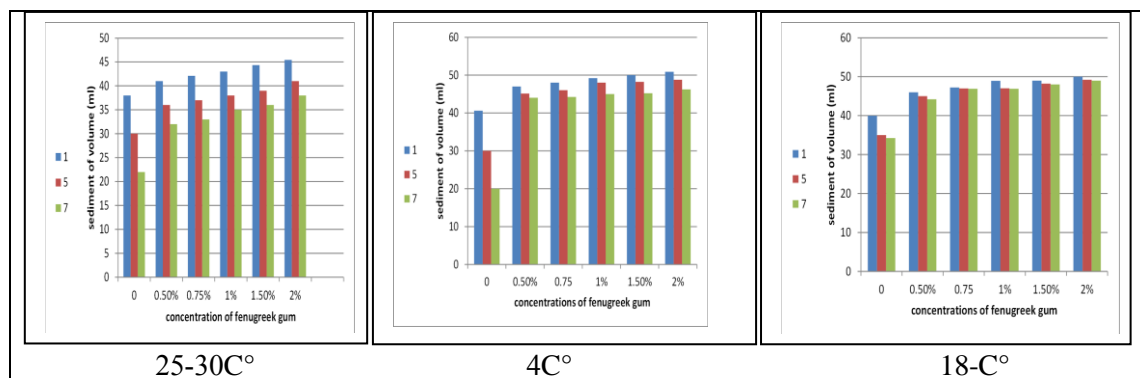


Figure 4. Effect of different temperatures on sediment of volume.

3.3. Effect of fenugreek gum addition on Electrical conductivity and Turbidity

The results of figure 6 and 7 showed that the increase in the values of Electrical conductivity and Turbidity in bread containing gum range between 3 – 4.11 , 4 – 5 , 3.57 – 4.5 cm /mm respectively and 11 – 13.99 , 19 – 23.01 ,29.55 – 34.44 NTU respectively compared the control sample 2.6,2.64 and 3.9 dcmm , 10.32 ,11.93 and 25.93 NTU at different temperature storage.

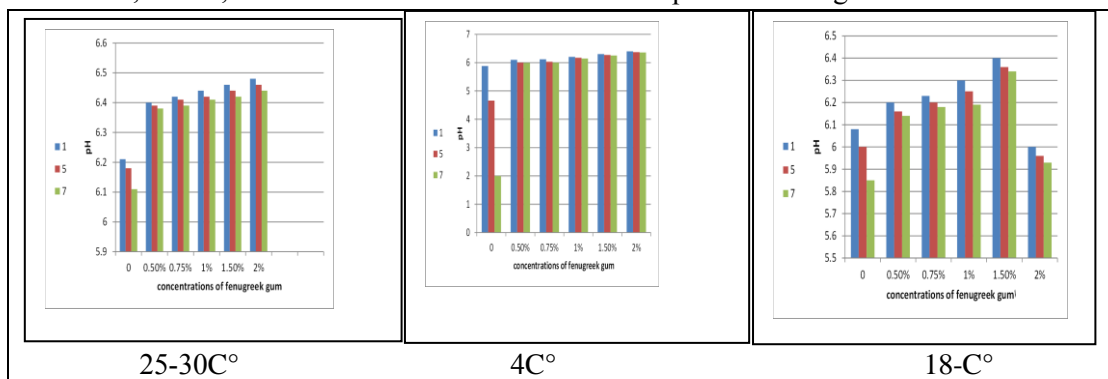


Figure 5. Effect of different temperatures on pH.

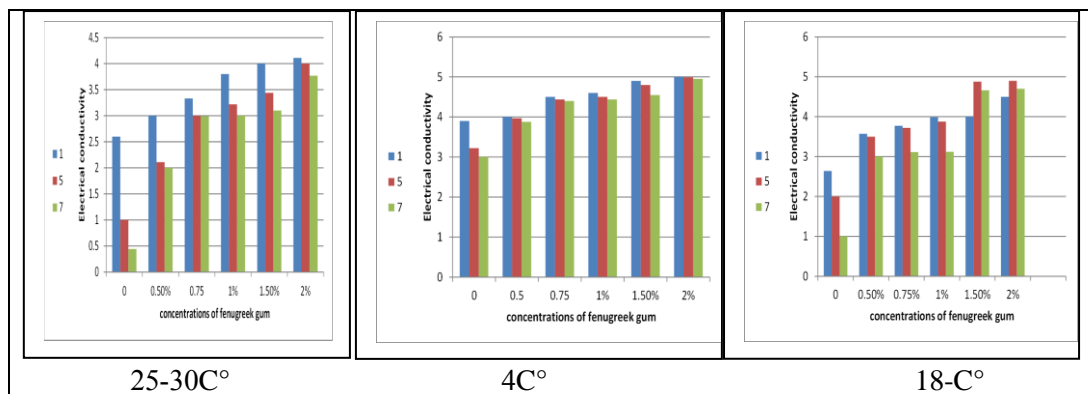


Figure 6. Effect of different temperatures on Electrical conductivity.

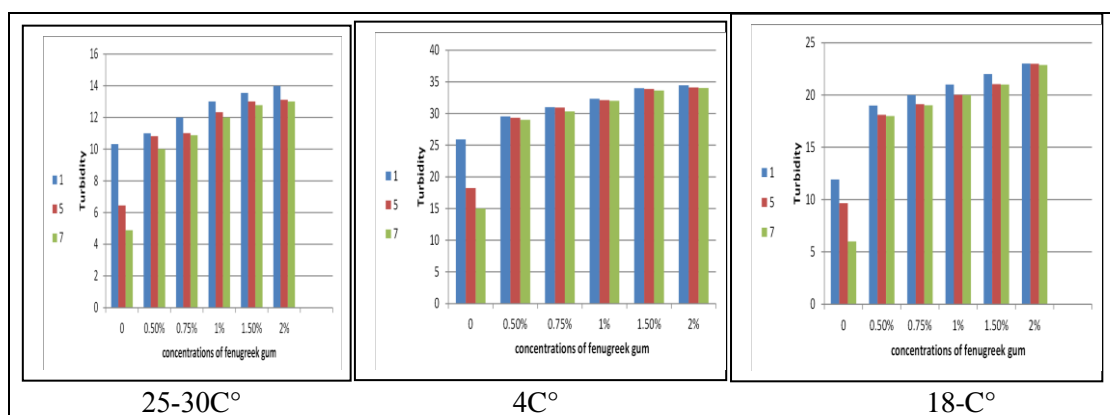


Figure 7. Effect of different temperatures on turbidity.

The staling bread was caused by the transformation of the starch from the amorphous state to crystallization [13,14].

3.4. Differential Scanning Calorimetry (DSC)

The enthalpies of bread stored at temperature 25- 30 , 4 and 18- C° and storage periods of 1 and 5 days are presented in Tables 2 ,3 and 4 , from tables could be seen The enthalpy increased as the storage , the that highest enthalpy was observed in the control sample range between 57.98 - 75.69 , 41.86 -54.12 and 27.67 - 38.91 J/g respectively , while the lowest enthalpy in bread containing gum 26.24 – 28.14 , 26.78 - 29.41 and 13.30 -15.90 J/g respectively at concentration of 2% during a storage period of 1 and 7 days at different temperature storage. The result was in agreement with [15] that there is a change in the enthalpy in the bread with gum added during storage on the first ,third and fifth days compared the control.

Table 2. Effect of adding different concentrations of fenugreek gum on staling bread at 25 -30C°using a technique DSC.

Days	T0		Tp		ΔH	
	1	7	1	7	1	7
Treatment A	283.07	252.1	303.08	273.13	57.98	75.69
Treatment D	301.40	303.51	315.78	317.78	28.40	29.41
Treatment E	305.4	301.40	319.8	314.55	26.24	28.14

Tp: peak temperature , To: onset point temperature, ΔH: enthalpy(J/g)

* A control , ‘D: bread containg fenugreek gum 1.5% ‘E : bread containg fenugreek gum 2%

Table 3. Effect of adding different concentrations of fenugreek gum on staling bread at 4C° using a technique DSC.

Treatment	T0		Tp		ΔH	
	1	7	1	7	1	7
A	298.03	290.63	312.90	308.39	41.86	54.12
D	302.72	298.03	316.54	312.90	36.55	41.86
E	302.98	303.51	319.07	317.78	26.78	29.41

Tp: peak temperature , To: onset point temperature, ΔH: enthalpy(J/g)

* A control , ‘D: bread containing fenugreek gum 1.5% ‘E : bread containing fenugreek gum 2%

Table 4. Effect of adding different concentrations of fenugreek gum on staling bread at 18- C° using a technique DSC.

Treatment	T0		Tp		ΔH	
	1	7	1	7	1	7
A	304.01	287.85	317.29	306.97	27.67	38.91
D	318.41	305.02	335.54	316.88	14.04	15.92
E	311.91	306.93	323.25	218.77	13.30	15.90

Tp: peak temperature , To: onset point temperature, ΔH: enthalpy(J/g)

* A control , ‘D: bread containing fenugreek gum 1.5% ‘E : bread containing fenugreek gum 2%

3.5. Scanning Electron Microscopic (SEM)

It was noticed from the pictures in figures ,The result of Scanning Electron Microscopic that addition fenugreek gum at concentration of 2% had improved the composition of bread as it was characterized by the presence of starch granules and good distribution of moisture inside the bread compared the control at different temperatures storage for 1 and 7 days .Addition of fenugreek gum cause delaying the staling bread due to the high moisture content of the bread containing gum was to bond with water through the hydroxyl groups in its composition and retained by preventing the formation of ice crystals during storage [16,17] , the result was agreement with [13] and agree also with [18].

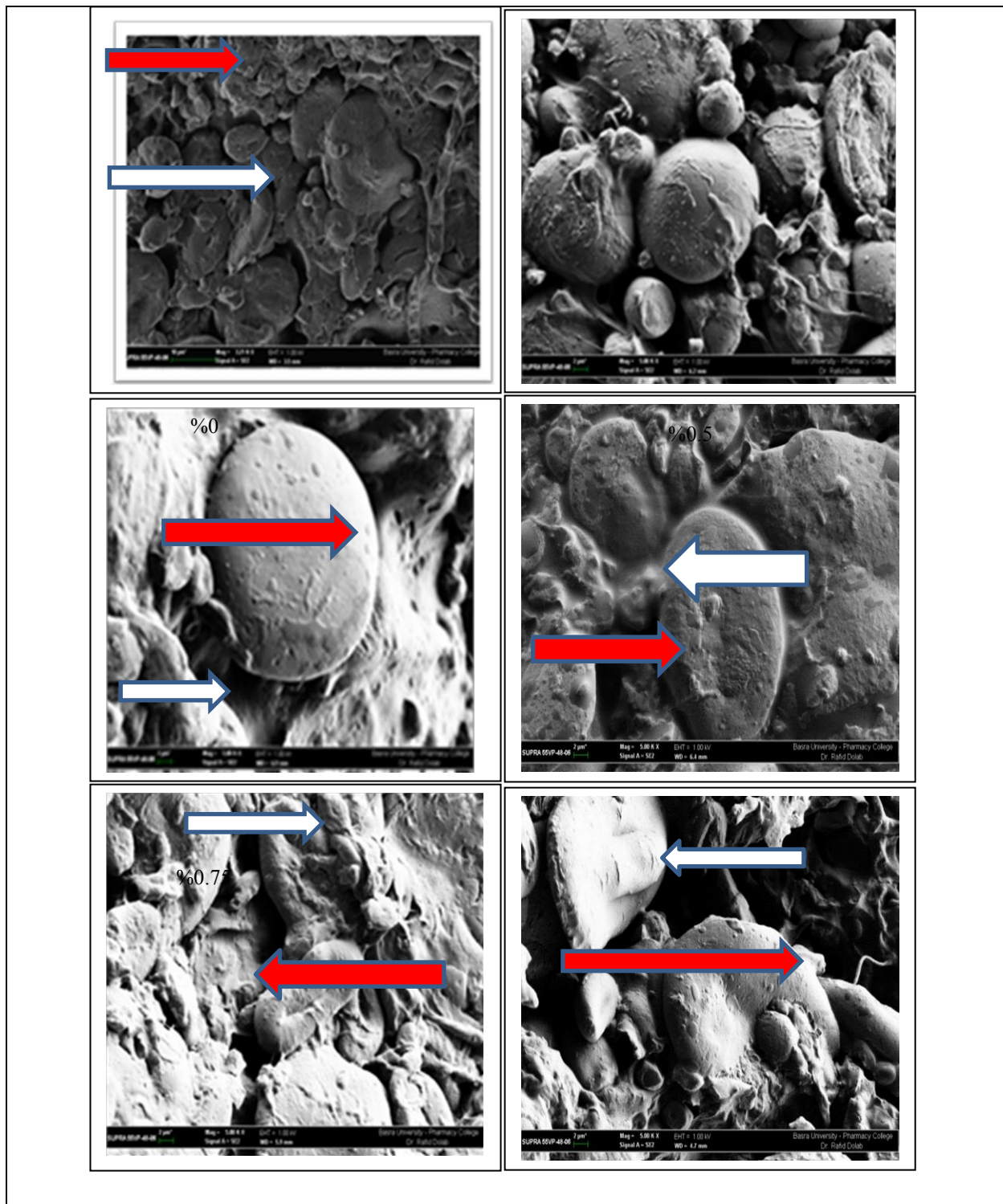


Figure 8. The microstructure of bread containing fenugreeki gum storage for 1 day at temperature 25-30 C°, white arrows show the presence of starch granules, red arrows show the presence rigid areas.

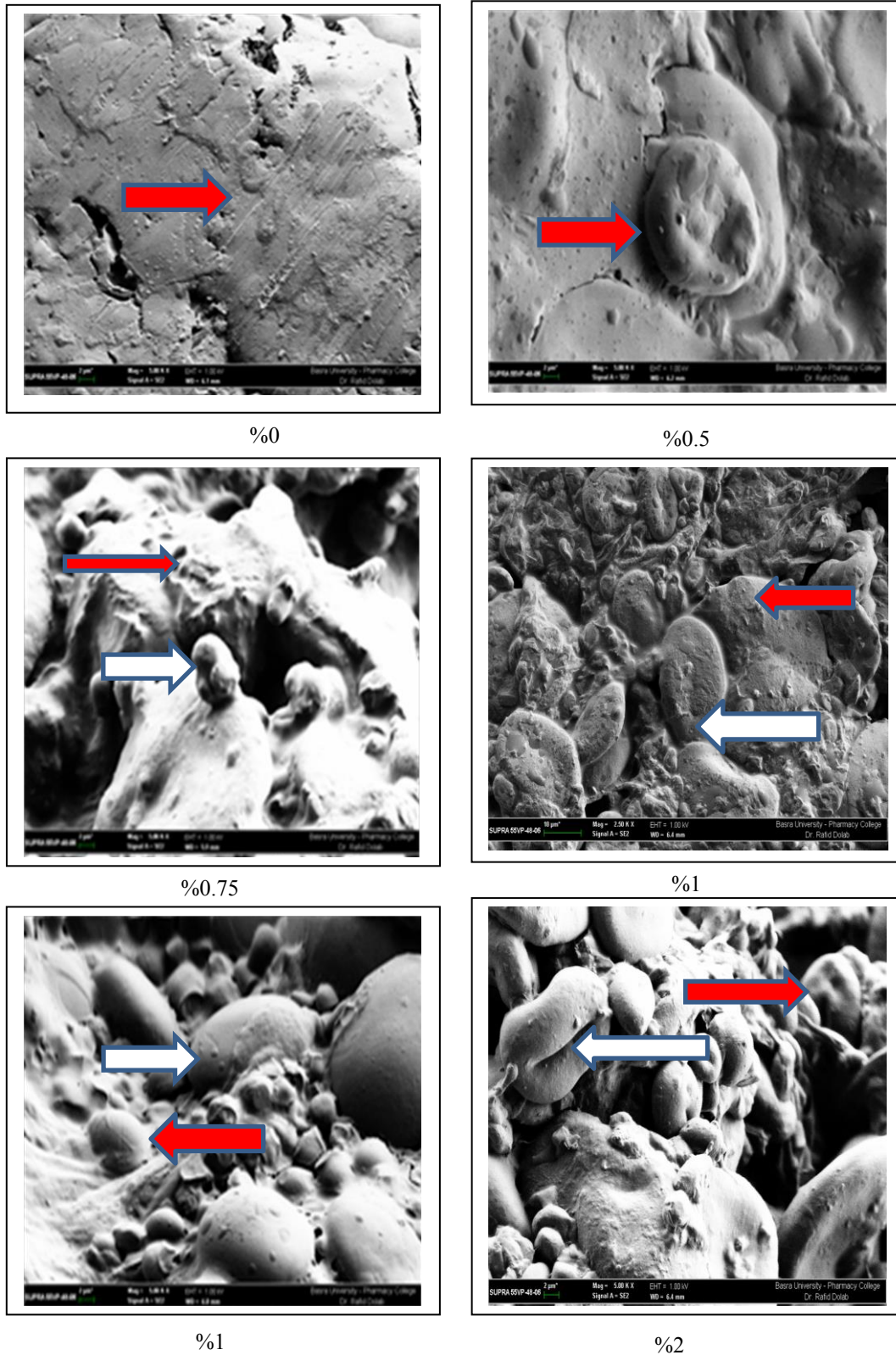


Figure 9. The microstructure of bread containing fenugreek gum storage for 7 day at temperature 25-30 C°, white arrows show the presence of starch granules, red arrows show the presence rigid areas .

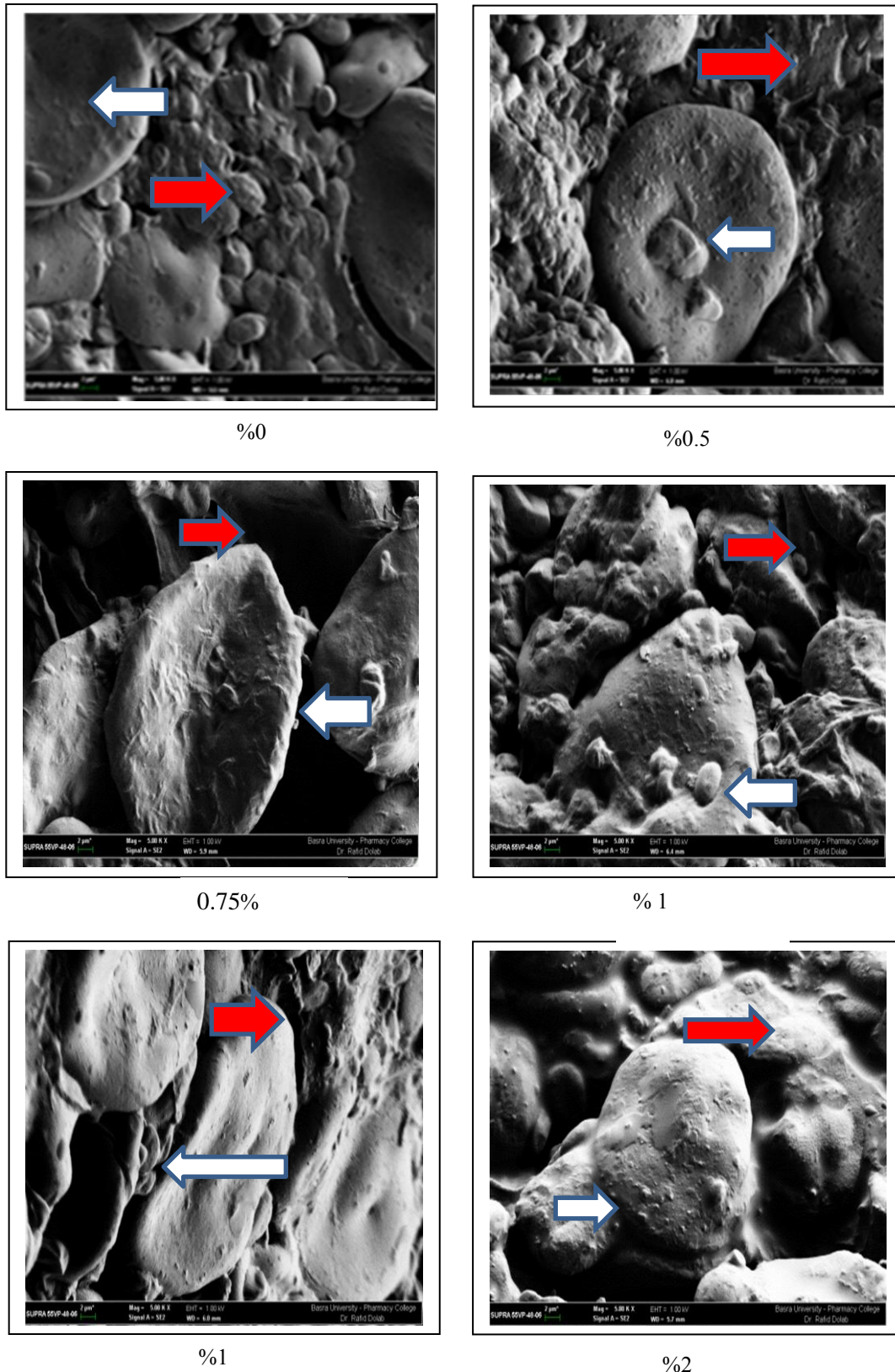


Figure 10. The microstructure of bread containing fenugreek gum storage for 1 day at temperature 4 C , white arrows show the presence of starch granules, red arrows show the presence rigid areas.

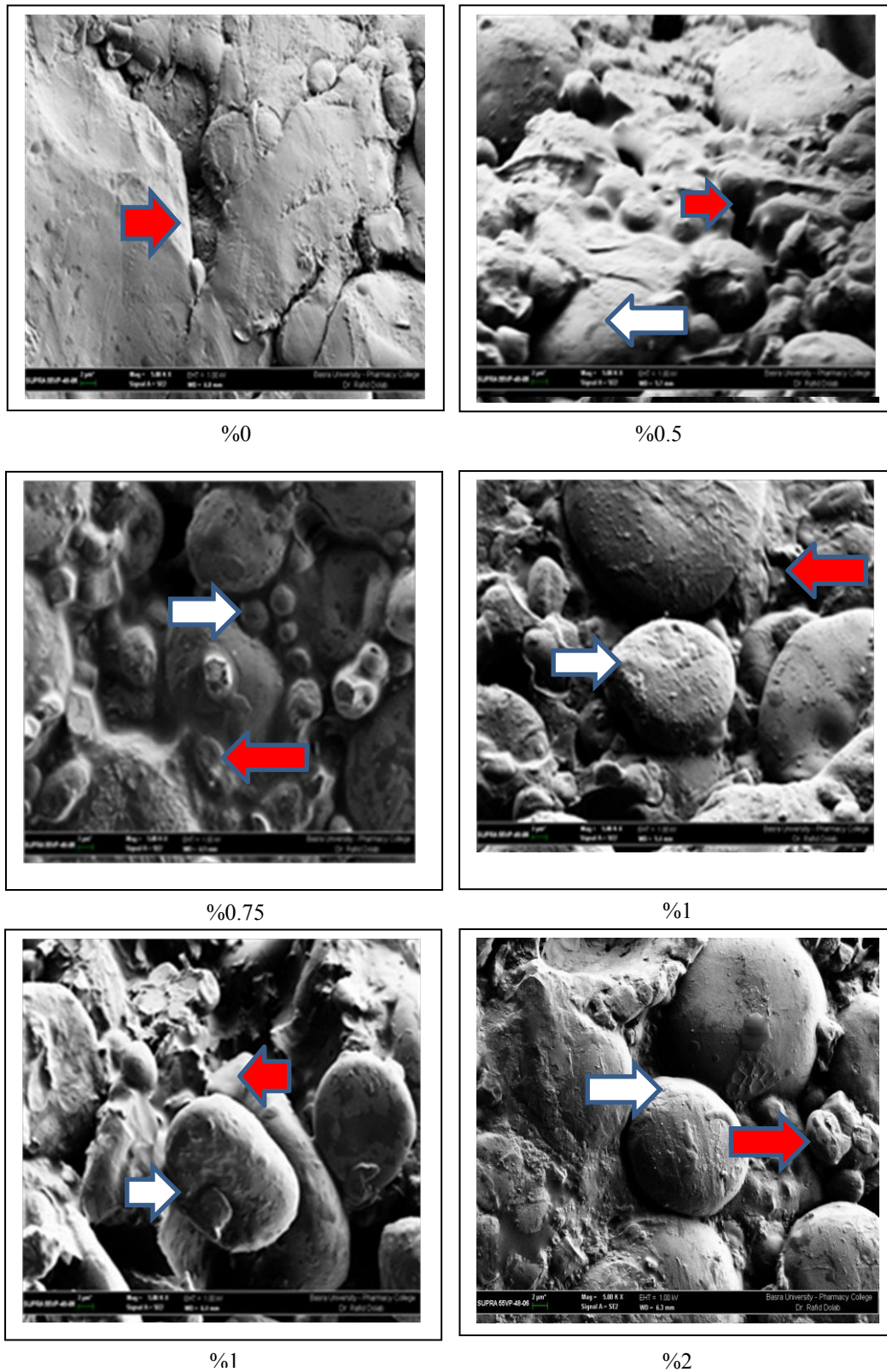


Figure 11. The microstructure of bread containing fenugreeki gum storage for 7 day at temperature 4C°, white arrows show the presence of starch grnules, red arrows show the presence rigid areas.

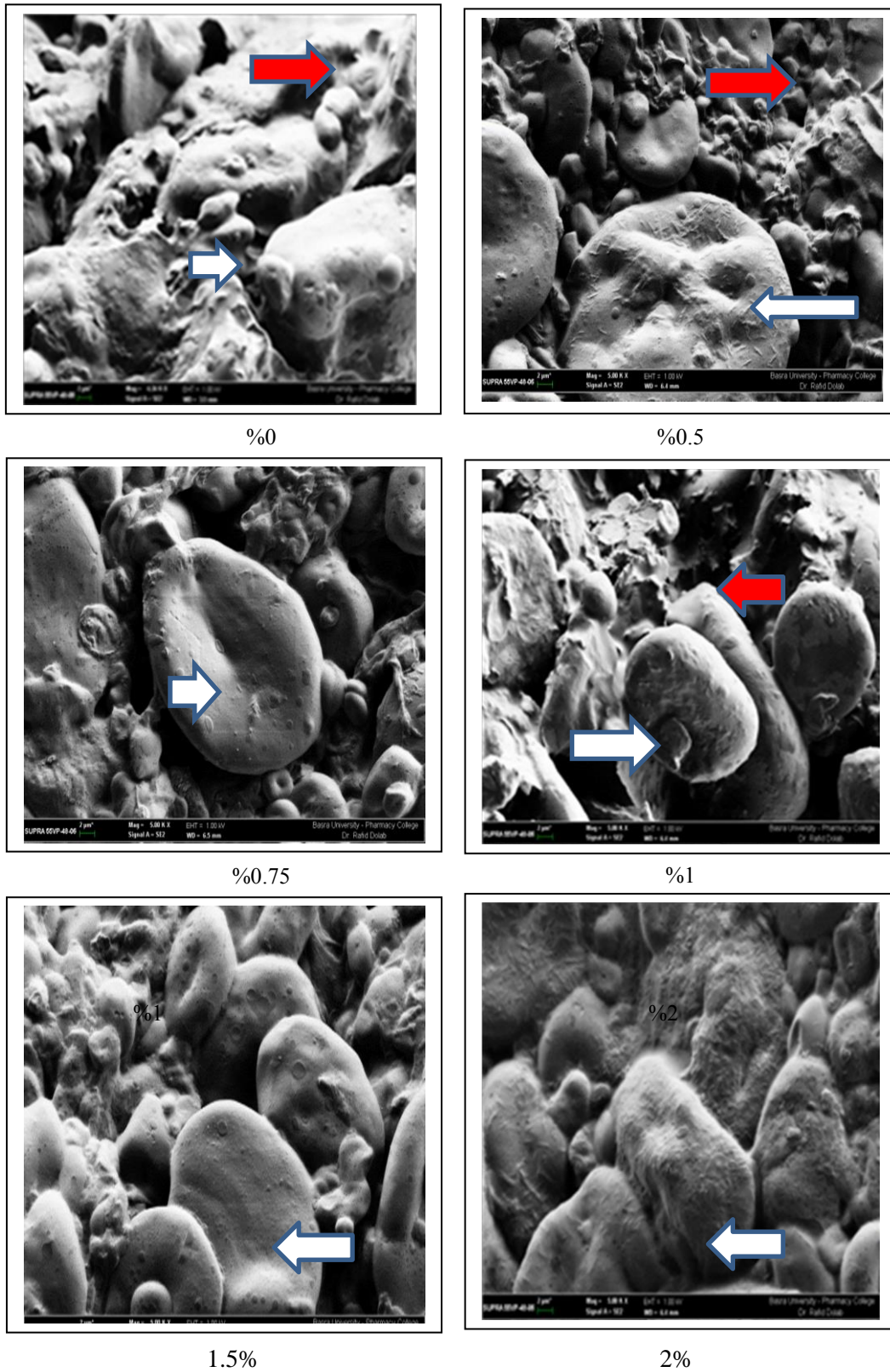


Figure 12. The microstructure of bread containing fenugreek gum storage for 1 day at temperature 18- C°, white arrows show the presence of starch granules, red arrows show the presence rigid areas.

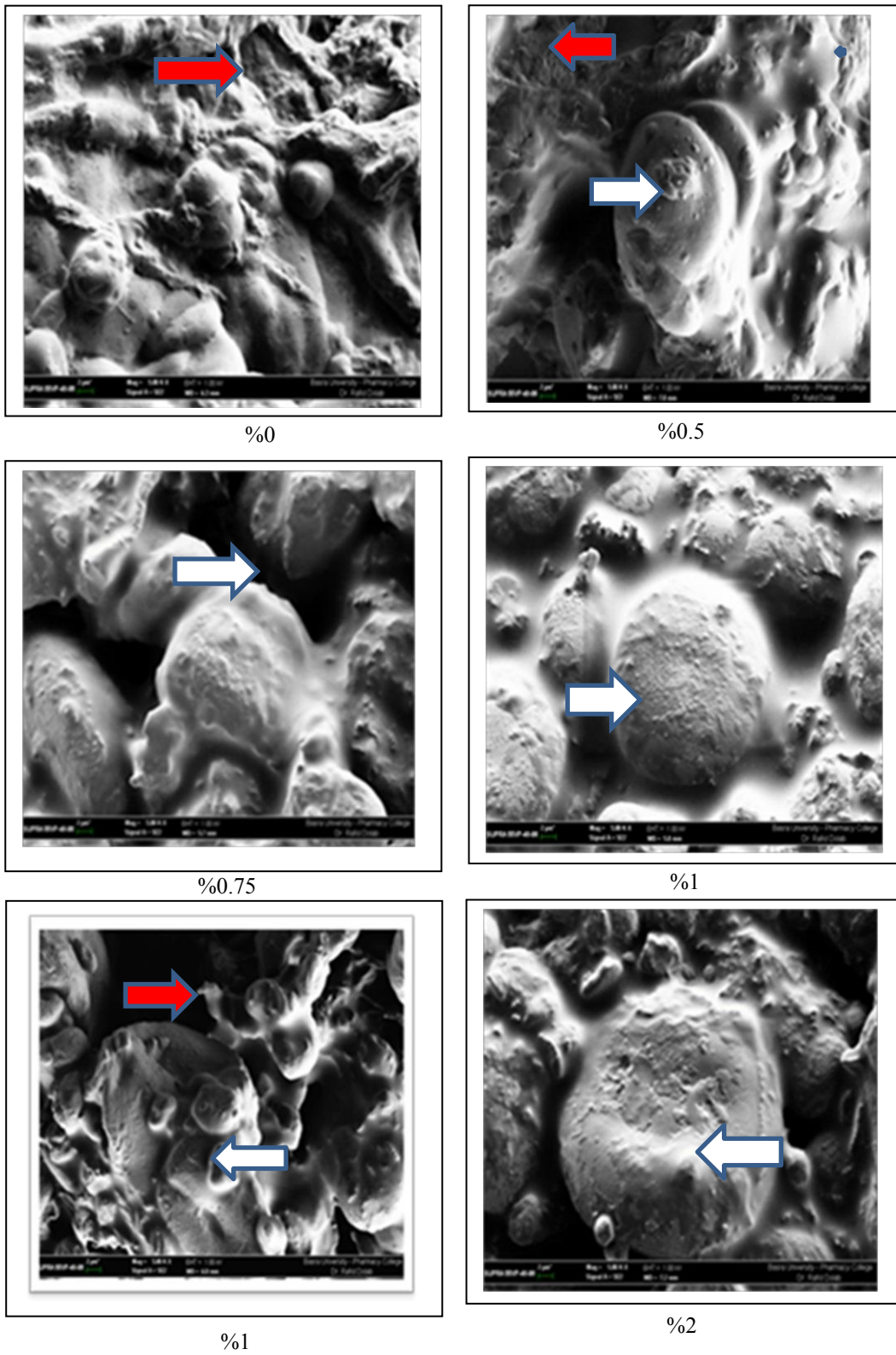


Figure 13. The microstructure of bread containing fenugreek gum storage for 7 days at temperature 18- C°, white arrows show the presence of starch granules, red arrows show the presence rigid areas.

Conclusions

The results showed that addition fenugreek seeds gum in bread cause an increase in the values of moisture content in the crumb, Swelling Power, pH, volume of sediment, Electrical conductivity and Turbidity while the decrease moisture content in the crumb. The result also indicate that bread containing gum had lower staling while the control sample had higher staling. The microstructure analysis showed addition fenugreek seeds gum improved the bread quality because that gum reduce hardness and staling of bread during storage due to higher water absorption. The least hardness was showed for bread stored at lower temperature 4°C. Addition of fenugreek seeds gum at the concentration of 2% increase the softness of crumb bread.

Acknowledgements

Authors would thank to staff of Food Science, Collage of Agriculture, University of Basrah for space and support the work.

References

- [1] Alobo, A. P., and Arueya, G. L. (2017). Effect of *Grewia venusta* fresen mucilage on the proximate composition, physical and Sensory properties of bread produced from wheat and cassava composite flours, *International Journal of Food Studies*, 6:192-200. *Food*, 12(2):141-149.
- [2] Esmalelifard, V.; Tarzi, B. G. and Nezhad, R., A. (2017). The effect of marve seed gum (*Salvia macrosiphon* Boiss) on the qualitative and rheological properties and staling of baquette bread. *J. of Food Bio. and Techol.*, 7(1): 73-79.
- [3] Hadnadev, T. R. D.; Dokic, L. P.; Hadnadev, M. P.; Rakita, S. M. and Torbica, A. M. (2013). Changes in quality parameters of bread supplemented with osa starch during storage. *Food and Feed Research* 40(2):101-108.
- [4] Hao, M. A.; Hasnain, A.; Jamli, K. and Haider, M. S. (2014). Extraction and characterization of gum from *Cordia myxa*. *Asian J. of Chem.*, 1(26):122-126.
- [5] Mahmood, K.; Alamri, M. S. and Mahmood, A. A. A. (2015). Gum cordia: Physical-functional properties and effect on dough rheology and pan bread quality. *Quality Assurance and safety of crops and Foods*. 7(4):589-579.
- [6] Kohajdova, Z. and Karovicova, J. (2009). Application of hydrocolloids as baking improvers. *Chemical Paper.*, 63 (1):26-38.
- [7] Raychaudhuri, D. L. U.; and Chakraborty, R. (2013). Role of hydrocolloids in improving the physical and textural characteristics of fennel bread. *International Food Research Journal*, 20(5):2253-2259.
- [8] Lopez, E. P. and Perez (2013). Effect of Brea gum on the characteristics of wheat bread at different storage times, *J. Food Sci. Techol.* 33(4):745-752.
- [9] Nazni, P. and Vigneshwar, P. (2014). Study on extraction and organoleptic evaluation of okra and hibiscus mucilage in corporate products. *Inter. J. of Food and Nutritional Sci.*, 3(1):99-103.
- [10] AACC. (2000). *Approved Methods of the American Association of Cereal Chemists*. 10th ed. Am. Assoc. Cereal Chem, St. Paul, MN.
- [11] AACC. (1998). *Approved Methods of the American Association of Cereal Chemists*. 10th ed., St. Paul, Minnesota, USA.
- [12] Koksel, H., F. (2009). Effects of Xanthan and Guar on Quality and Staling of Gluten Free Cakes Baked in Microwave- infrared Combination Oven.. Master Thesis. Middle East Technical University, pp200.
- [13] Abdul aziz, L. H. N. A.; Bhat, R. and Azahari. (2014). Storage studies of bread prepared by incorporation of the banana pseudo-stem flour and the composite breads containing hydrocolloids. *CyTA-Journal of*
- [14] Salehifar, M. (2011). Effect of protein variation on starch crystallinity and bread staling. *International Conference on Food Engineering and Biotechnology*, 9 : 300 -304.

- [15] Gavilighi, H., A.; Azizi, M., H.; Barzegar, M. and Ameri, M., A. (2006). Effect of selected hydrocolloids on bread staling as evaluated by DSC and XRD. *Journal of Food Technology*, 4(3): 185-188.
- [16] Abadi, Z. F.; Far, M. S.; Ishaghi, M. R. (2015). Investigating the qualitative characteristics of toast bread obtained from par-baked paste kept in the fridge and the freezing condition over zero degree. *Journal of Applied Environmental*, 5(6): 278-286
- [17] Saleh, A. E., Abdullah, B. Y., Nazal, A. L. (2016). Study the preservation and microbial quality of bread and flour produced in Tikrit city, *J. of Tikrit Science*, 2(14): 222-240.
- [18] Sahari, M. A., Mohammadi, R. and Esfehiani, Z. H. (2014). Rheological and quality characteristics of Taftoon bread as affected by salep and Persian gums. Hindaw Publishing Corporation, *International journal of Food Science*, Volume 2014 Article ID813286, p:7.