ENHANCE OF FLAVOR AND SOME MICROBIAL PHYSICOCHEMICAL AND SENSORIAL PROPERTIES OF YOGURT BY DRIED CANTALOUPE PULP

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ABSTRACT

This study was aimed to enhance the flavor compounds, improve sensorial, microbial and physicochemical characteristics of the yogurt product using dried cantaloupe pulp. This study included the estimation of three flavor compounds in the yogurt product (acetaldehyde, acetone, and ethanol), after seven day of refrigeraed storage at 4°C, a wide difference in the levels of flavor compounds among the treatments have been shown, the values of acetaldehyde were in the following treatments (A) control treatment, (H) cantaloupe 1 %, (K) cantaloupe3%, as follows 13.46, 14.27, 24.54 mg/L respectively. Acetone values were 8.38, 5.33, 3.47 mg/L respectively. Ethanol were 10.25, 7.12, 4.29 mg/L respectively. *Lactobacillus delbrueckii* subsp. *Bulgaricus* log vaible count after the first day of manufacture were 7.38, 8.53, 8.77 *cfu* ml^{-1} for A, H and K treatment respectively, gradually decreased through refrigerated storage to reach after 28 days 6.25, 7.41, 7.60 *cfu* ml^{-1} respectively. The log vaible count *Streptococcus silvarius* subsp. *Thermophilus* at first day of manufacture were 8.20, 9.66, 9.71 *cfu* ml^{-1} for A, H and k treatment respectively, gradually decreased under refrigerated storage to 7.25, 8.50, 8.30 *cfu* ml^{-1} respectively after 28 days. Chemical composition did not change, and there were no significant differences among the treatments. Sensory evaluation values showed differences in treatment, the flavor scores for treatments after 28 days of refrigerated storage were (37, 42, 43), the texture were (25, 28, 29), the appearance were (10,14, 14), color (9, 8, 8) for A, H and k treatment respectively. The treatment K was superior as compared to the other treatments with a score of acceptance (94), compared with the control treatment whose score of acceptance was(81) out to 100

Keywords: acetaldehyde, starter, acetone, ethanol. .
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مجلة العلوم الزراعية العراقية- 559-552:(1)55:2024 **الزوبعي والزوبعي**

تعزيز النكهة وبعض الصفات المايكروبية و الفيزيوكيميائية والحسية لليوغرت بأستعمال لب البطيخ المجفف

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المستخلص

هدفت الدراسة إلى تعزيز النكهة وتحسين الخصائص الحسية والميكروبية و الفيزيوكيميائية لمنتج اليوغرت باستعمال لب ثمار البطيخ المجفف. تضمنت الدراسة تقدير ثلاثة مركبات نكهة في منتج اليوغرت (الأسيتالديهايد ، الأسيتون ، الإيثانول). حيث أظهر الخزن المبرد اختلافا كبيرا في مستويات مركبات النكهة بين المعاملات ، كانت قيم الأسيتالديهايد في المعاملات : معاملة السيطرة (A) والمعاملة (H) الحاوية على البطيخ المجفف1٪ و المعاملة (K) الحاوية على البطيخ المجفف 3٪ بواقع 13.46 ، 14.27 ، 24.54 ملغم / لتر على التوالي و كانت قيم الأسيتون 8.38 ، 5.33 ، 3.47 ملغم / لتر على التوالي و الإيثانول 10.25,7.12, 4.29 ملغم / لتر على التوالي. كانت اعداد بكتريا *Lactobacillus delbrueckii* subsp.*bulgaricus* بعد اليوم الأول من التصنيع 7.38 ، 8.53 ، 8.77 و.م.م / مللتر للمعاملات (A، H، K) على التوالي ، ثم انخفضت الاعداد تدريجيًا ليصبح بعد 28 يومًا من الخزن المبرد 6.25 ، 7.41 ، 7.60 و.م.م /مللتر على التوالي. اما بكتريا *Streptococcus silvarius* subsp.*thermophillus* فكانت بعد اليوم الأول من التصنيع 8.20 ، 9.66 ، 9.71 و.م.م / مللتر للمعاملات (A، K,H) على التوالي ، ثم انخفضت الاعداد تدريجيًا ليصبح بعد 28 يومًا من الخزن المبرد 7.25 ، 8.50 ، 8.30 و.م.م /مللتر على التوالي. عند تقدير التركيب الكيمياوي لم تكن هناك فروق ذات دلالة إحصائية بين المعاملات. أظهرت نتائج التقييم الحسي اختلافات معنوية بين المعاملات ، فكانت الدرجات التي حصلت عليها صفة النكهة لجميع المعاملات بعد 28 يومًا من الخزن المبرد (37 ، 42 ، 43) من 45 و درجات القوام كانت (25 ، 28 ، 29) من 30 و درجات المظهرالخارجي كانت (10 ، 14 ، 14) من 15 اما درجات اللون فكانت (9 ، 8 ، 8) من 10, للمعاملات (A, H , K) على التوالي. تفوقت المعاملة K على باقي المعاملات بدرجة قبول (94) مقارنة بمعاملة السيطرة التي كانت درجة تقبلها (81) من 100 .

الكلمات المفتاحية: الأسيتالديهايد، البادئ، الاسيتون، الايثانول.

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INTRODUCTION

Yogurt has topped the list of fermented dairy for thousands of years and has entered the human diet, it is become one of the main meals that provide him with the important nutrients the body needs in performing its biological activities. Yogurt was found by chance as a result of the activity of microorganisms and their effects on the components of milk, and this coincidence was an important factor in prolonging the shelf life of milk by turning the milk into a fermented milk that lasts for several days, the most important thing that distinguishes yogurt from other fermented milk products is the distinctive flavor of yogurt, which is due to lactic acid and the rest of the flavor compounds resulting from the fermentation processes of milk by the yogurt starter, and among the most prominent of these compounds are aldehydes, ketones, acids and alcohols (26). Acetaldehyde is one of the most important flavor compounds in yogurt which is an important criterion for the acceptance of the product by some consumers. Glucose, catechol, glyceraldehyde, acetylene, amino acids such as threonine, and deoxyribonucleic acid (DNA) can act as the acetaldehyde precursors, it was found that the weak flavor in the yogurt product when the acetaldehyde level was less than 4.0 ppm, which is considered an imperfect amount, while the good flavor of the yogurt that produced acetaldehyde level reaches 8.0 ppm or more (24).As for alcoholic flavor compounds such as ethanol and acetone, they are other necessary compounds in yogurt, but their presence is within certain limits and increasing their production is undesirable (25). Cantaloupe or Melon (Cucumis melo) are fruit widely cultivated in most regions of the world, cantaloupe has a heavily netted rind and usually orange flesh, or it is a fruit with a rough hard warty rind, cantaloupe are important commercial crops and are consumed all over the world. The cheap price of cantaloupe, wide spread, distinct flavor and nutritional elements such as amino acid, carbohydrates,minerals, vitamins, antioxidants (phenolics and Carotenoids) and gamma-aminobutyric acid (GABA), all these reasons made cantaloupe an important commercial crop (3, 4). Therefore, it became necessary to develop the flavor in the yogurt product, without causing the slightest harm to the health of the consumer through the use of herbs, vegetables and fruits, Which are widely spread, cheap and safe for health, these plants have been used in a lot of research related to the development of flavor compounds such as basil seeds (7) and water melon (30). The main target of the present study is using the dried cantaloupe fruit pulp in the production of yogurt to increasing of yogurt starter count, and improving the sensory properties.

MATERIALS AND METHODS

Cantaloupe were purchased from local market of Baghdad, cantaloupe was cut up to small pieces (with 3 cm of diameter , 4 –5 mm of thickness) and dryed in the oven at 40 ˚C until the weight level was constant according to (14). Then the dried cantaloupe was stored in sealed containers at 4˚C, until use. yogurt was produced using a standard yogurt manufacturing process (29). Dried cantaloupe was added as A control treatment (with out adding), H treatment (cantaloupe 10g/ L milk. and K teatment (cantaloupe 30g /L milk. The commercial classic yogurt starter containing *Lb. bulgaricus* and *S. thermophilus* (Sacco lyofast companuy, Italy) was used in the production of yogurt. The starter of yogurt was activated individually in MRS broth and M17 broth (Hi-media, India) in 45 ˚C and 37˚C respectively, then using reconstituted skim milk powder (12%) triplicate until complete activation process then mix 1:1 as activated starter then added in 3% to all treatments (28) . To determine the microbiological criteria of yogurt as follow; MRS agar was used determined *Lb. bulgaricus* count and incubated at 45 ˚C for 72 hours, M17 Agar was used and incubated at 37˚C for 48 h to account *S. thermophilus* , MacConkey agar was used to count coliform bacteria and incubated at 37˚C for 48 h, Nutrient agar was used to count psycrotrophic bacteria and incubated at 4˚C for 10 days and PDA agar was used to count molds & yeasts and incubated at 25°C for 5 days (5, 12, 13). According to (1), 10g of sample was mix with 90 ml deionized water for determined pH value by using a digital pH meter. Moisture, protein, fat and ash were determined according to (1 , 15). Flavor compounds (acetaldehyde, acetone, and

ethanol) of yogurt were evaluated by gas chromatography (GC), samples were prepared using steam distillation of 100 mL of the sample, to obtain 25 mL of the distillate. A glass column (1.5 m in length, 4 mm) was used. The solid support was a diatomit CQ 100/120 mesh, the liquid phase was argon with a flow rate of 40 mL/min. The detector temperature was 250°C, the column temperature 100°C,the evaporator temperature was 150°C. The calculations were performed based on a DP 68 PYE Unicam integrator, according to(1). Sensory evaluation was performed of yogurt samples by six professional specialists in food sciences department and General Directorate of Agricultural Research – ministry of agriculture, used the evaluation form for the yogurt according (19). Statistical Analysis System- (27) program was used to detect the effect of difference factors in study parameters.

RESULTES AND DISCUSSION

Yogurt starter count

The results in (table 1) showed *Lb. bulgaricus* count in yogurt treatments at refrigerated storage. The account after the first day of manufacture were 7.38, 8.53, 8.77 *cfu* ml^{-1} for A, H and K treatments respectively, then gradual decreasing through storage periods to registered after 28 days 6.25, 7.41, 7.60 *cfu* ml^{-1} respectively. *S. thermophilus* log vaible count were determined after the first day of manufacture 8.20, 9.66, 9.71 *cfu* ml^{-1} for A, H and K respectively, after 28 days of refrigerated storage, *S.thermophillus* decreased in count to reached 7.25, 8.50, 8.30 *cfu* ml^{-1} respectively. Decreasing *Lb. bulgaricus* and *S. thermophillus* count may be due to droping in pH. High acidity was due to the consumption of lactose and the production of lactic acid. Also the secondary metabolites in the environmental will increase during incubation period more than that storage period and this affected the viability starter bacteria cells, these results are in agreement with (18). cantaloupe 3% (K) was the highest treatment in *S. thermophillus* and *Lb. bulgaricus* count because cantaloupe contains good nutrients that promoted the growth and activity of yogurt starter bacteria such as amino acids as a nitrogen source, lactose as a carbon source, and mineral elements important for the growth (14).

Coliform, psycrotrophic bacteria and yeast& mold count: Coliform, psycrotrophic bacteria and yeast and mold were absence in all treatments of yogurt (table1), this may be attributed to the selection of good quality raw materials that have been used in yogurt manufacture, are essential in controlling microbial contaminations in food, the efficiency of the pasteurization process and the absence of the manufacturing and storage from the causes of contamination with pathogenic and spoilage microorganisms causes spoilage of dairy products, addition to the activity of the starter culture in the production of lactic acid, acetic acid and bacteriocins, which acts as an antibacterial and antifungal , these results are in agreement with the findings of (10,11,17,22).

Physicochemical tests

Table2 illustrate that the pH values on the first day after manufacturing were 4.42, 4.49 and 4.52 for A, H and K treatments respectively , then gradually decreased after 28 days of refrigerated storage became 4.06, 4.3 and 4.37 respectively, the reason was yogurt starter bacteria consumed lactose sugar and produced lactic acid, which led to a decrease in pH values, these results are consistent with the results obtained by (30). The highest pH value was for the treatments K cantaloupe 3% and H cantaloupe 1% due to the high pH value in cantaloupe, and this matches the results reached (14). There was a slight decreasing in moisture during the storage period, and the reason for this was the evaporation of moisture during storage, these results are in agreement with the results (21). the moral difference was clear ($p<0.05$) between the same treatments during each storage period, it was found that the moisture ratios in treatments, H cantaloupe 1% and K cantaloupe 3% were lower than control treatment, (Table 2) and it isbelieved that the reason for this is the high percentage of solids due to the addition of dried cantaloupe, in which the percentage of solids increases in cantaloupe, (16). Protein, fat and ash increased during the storage period and for all treatment, including the control treatment, (Table 2) , these results are in agreement with the results (8). Which indicated that the

contents increased during the storage period, these results are in agreement with the results (21).

Table 1. Microbiological results of yogurt treated with cantaloupe during refrigeraed storage (28 day / 4°C) *(A)Control, (H)Cantaloupe1%,(k)Cantaloupe 3%.

Treatments	1 DAY	7 DAY	14 DAY	21 DAY	28 DAY	LSD value
			***Lb. bulgaricus* (log viable count *CFU* mL^{-1})**			
A	**7.38**	**6.49**	**6.34**	**6.30**	**6.25**	**1.10 ***
H	**8.53**	**7.57**	**7.54**	**7.50**	**7.41**	**1.08 ***
K	**8.77**	**7.87**	**7.79**	**7.70**	**7.60**	**1.10***
LSD value	**1.05 ***	**1.22 ***	**1.09 ***	**1.15 ***	**1.29 ***	**---**
			***S. thermophillus* (log viable count *CFU* mL^{-1})**			
A	**8.20**	**7.56**	**7.46**	**7.39**	**7.25**	**0.97 NS**
H	**9.66**	**8.74**	**8.69**	**8.60**	**8.50**	**1.12 ***
K	**9.71**	**8.69**	**8.56**	**8.46**	**8.30**	**1.18 ***
LSD value	**1.16 ***	**1.05 ***	**1.13 ***	**1.10 ***	**1.08 ***	**---**
			Coliform bacteria (log viable count *CFU* mL^{-1})			
A	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
H	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
K	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
LSD value	**NS**	**NS**	**NS**	**NS**	**NS**	**---**
			Yeast &Mold (log viable count *CFU* mL^{-1})			
A	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
H	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
K	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
LSD value	**NS**	**NS**	**NS**	**NS**	**NS**	**---**
			Psycrotrophic bacteria (log viable count *CFU* mL^{-1})			
A	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
H	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
K	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**NS**
LSD value	**NS**	**NS**	**NS**	**NS**	**NS**	**---**
*** (P≤0.05), NS: Non-Significant.**						

Table2. Physcichemical results of yogurt treated with cantaloupe during refrigerated storage (28 day / 4°C) *(A)Control, (H) Cantaloupe 1% ,(k) Cantaloupe3%

Treatments	1 DAY	7 DAY	14 DAY	21 DAY	28 DAY	LSD value
			Ph			
A	**4.42**	**4.4**	**4.37**	**4.2**	**4.06**	**0.416 NS**
G	**4.49**	**4.46**	**4.43**	**4.37**	**4.3**	**0.237 NS**
K	**4.52**	**4.5**	**4.48**	**4.44**	**4.37**	**0.293 NS**
LSD value	**0.193 NS**	**0.187 NS**	**0.166 NS**	**0.205 NS**	**0.347NS**	**---**
			Water			
A	**86.80**	**86.62**	**86.50**	**86.38**	**86.28**	**2.41 NS**
H	**85.62**	**85.50**	**85.39**	**85.3**	**85.16**	**1.87 NS**
K	**83.70**	**83.57**	**83.46**	**83.3**	**83.24**	**1.49 NS**
LSD value	**2.04 ***	**2.37 ***	**2.52 ***	**2.33 ***	**2.41 ***	**---**
			Protien			
A	**3.05**	**3.11**	**3.2**	**3.25**	**3.32**	**0.229 NS**
H	**3.13**	**3.19**	**3.31**	**3.37**	**3.41**	**0.298 NS**
K	**3.25**	**3.32**	**3.4**	**3.45**	**3.52**	**0.287 NS**
LSD value	**0.309 NS**	**0.288 NS**	**0.287 NS**	**0.307 NS**	**0.331NS**	**---**
			Fat			
A	**3.38**	**3.39**	**3.43**	**3.49**	**3.52**	**0.144 NS**
H	**3.38**	**3.40**	**3.44**	**3.51**	**3.52**	**0.150 NS**
K	**3.39**	**3.42**	**3.45**	**3.52**	**3.54**	**0,157 NS**
LSD value	**0.128 NS**	**0.122 NS**	**0.109 NS**	**0.114 NS**	**0.108 NS**	**---**
			Ash			
A	**0.69**	**0.7**	**0.74**	**0.75**	**0.76**	**0.167 NS**
H	**0.76**	**0.77**	**0.81**	**0.83**	**0.84**	**0.116 NS**
K	**0.84**	**0.85**	**0.88**	**0.9**	**0.91**	**0.097 NS**
LSD value	**0.216 NS**	**0.173 NS**	**0.194 NS**	**0.185 NS**	**0.179 NS**	**---**
*** (P≤0.05), NS: Non-Significant.**						

Flavor compounds tests

Acetaldehyde1: The results are shown in the (figure 1), acetaldehyde values were 13.46, 14.27 and 24.54 mg/L in the treatments (A, H and K) respectively. In treatment (H), it was found that acetaldehyde content increased compared with the control treatment, is due to addition of cantaloupe 1% a good source of threonine (14), which is a good nutrient for the starter culture, threonine represents one of the pathways of acetaldehyde formation (6, 25). For the same reason, treatment(K)containing cantaloupe 3% had a very high acetaldehyde content compared other treatments.

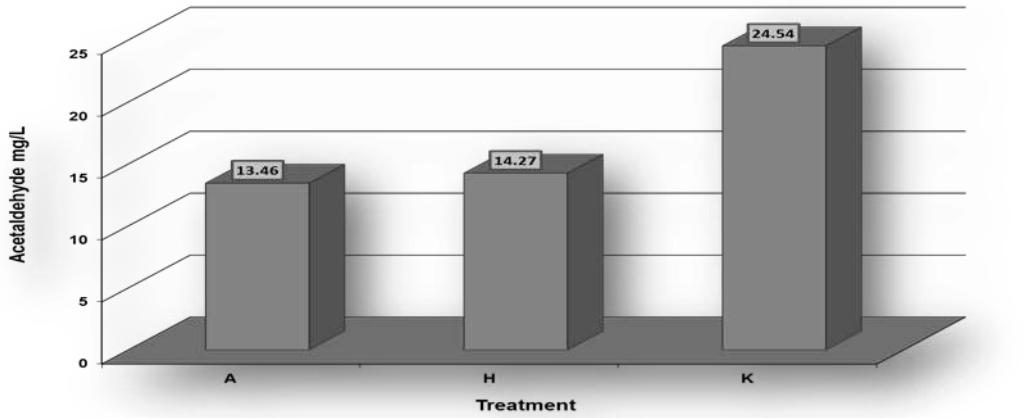

Figure 1. Acetaldehyde content (mg/l) in the experimental yogurt samples with cantaloupe

Acetone By looking at the figure 2, acetone values were 8.38, 5.33 and 3.47 mg/L respectively. in the trails A, H and K respectively. the level of acetone in the (H) cantaloupe 1% and (K) cantaloupe 3% treatments were lower than control treatment, the reason for this is that may be due to cantaloupe contains many nutrients that stimulate the growth and activity of yogurt starter in the production of an enzyme that removes the hydrogen atom from acetone and converts it to acetaldehyde by an (Alcohol dehydrogenase) as one of the pathways for the production of acetaldehyde from alcohol (6,25).

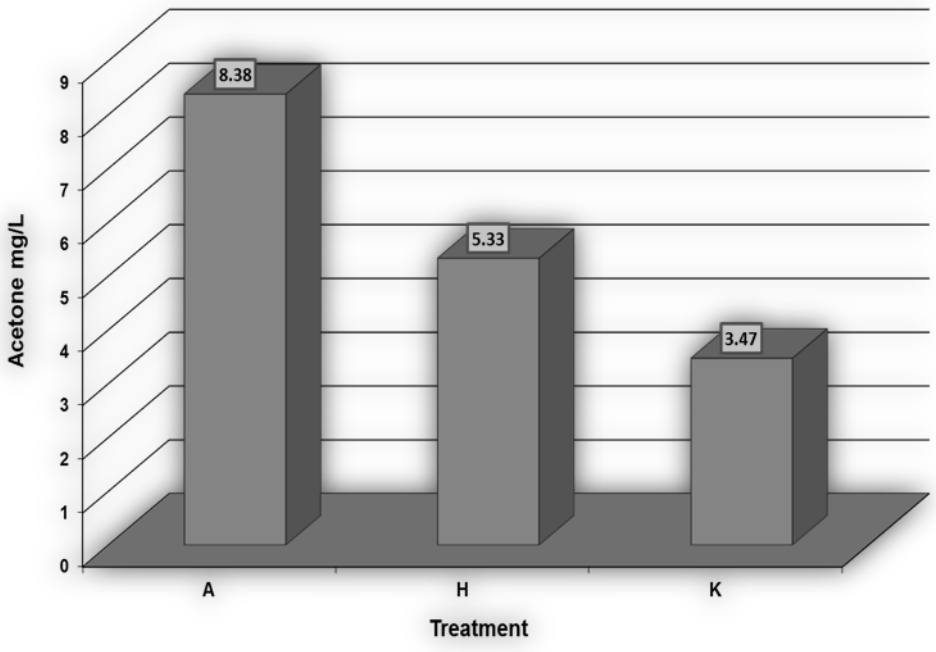

Figure 2. Acetone content (mg/l) in the experimental yogurt samples with cantaloupe

Ethanol

The results are shown in the Figure 3, ethanol value in control treatment A was 10.25 mg/L and the rest of the treatments H and K were 7.12 and 4.29 mg/L respectively. The level of ethanol in the(H) cantaloupe 1% and (K) cantaloupe 3% treatments were lower than control treatment, the reason for that cantaloupe contains many nutrients that stimulate the growth and activity of yogurt starter in the production of alcohol dehydrogenase that removes the hydrogen atom from ethanol and converts it to acetaldehyde as one of the pathways for the production of acetaldehyde from alcohol (6, 25), reducing the percentage of ethanol to the limits of these values brings us many benefits, such as getting rid of the undesirable alcoholic taste in the yogurt product.

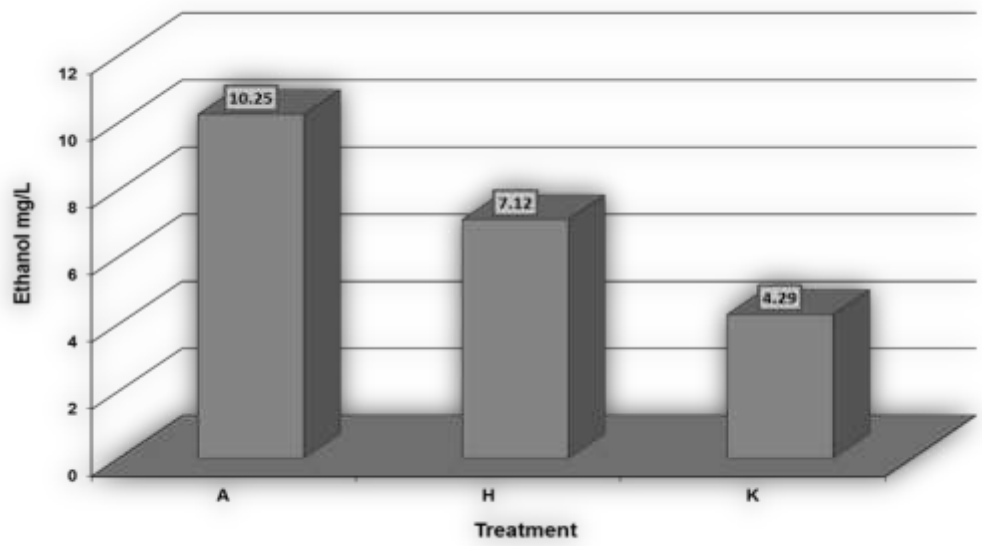

Figure 3. Ethanol content (mg/l) in the experimental yogurt samples with cantaloupe

Sensory evaluation

The results in (table 3) showed, treatment K cantaloupe 3% was the highest in flavor, texture and appearance scores compared to the rest of the treatments, because of the excellent flavor caused by increasing in the production of acetaldehyde and the low production ethanol and acetone (25), cantaloupe contains antioxidants, including the major phenolic compounds hydroxybenzoic, hydroxycinnamic and phenolic acid derivatives, as dry cantaloupe way leads to the enrichment of the formulated yogurt in phenolic compounds, which led to give an excellent flavor to the yogurt (9). The obtained result agrees with those reported by (2), in their respective studies about the fortified yogurt with Papaya and Cactus Pear fruits as well as natural plant antioxidant. the ability to retain water, the lack of whey exudation, the consistency of texture and the stability of acidity, which when it rises will cause a great exudation of the whey and thus the collapse of the texture. All these factors led to the improvement of the external appearance of the yogurt (25). K value may be the high percentage of solids such as proteins and fibers that help support the texture character of the yogurt product. (23)used mango fruits to enhance the yogurt product,which gave good sensory results, including improving the external appearance.The color of the treatments was K cantaloupe 3% and H cantaloupe 1% tends to the color of high-fat yogurt and this is due to the presence of carotenoids in cantaloupe(14).

Table 3. Sensory evaluation of yogurt samples treated with cantaloupe over refrigerated storage (28 day / 4°C) *(A)Control, (H) Cantaloupe 1% ,(k) Cantaloupe3%

Treatments	1 DAY	7 DAY	14 DAY	21 DAY	28DAY	LSD value
			Flavor (45)			
A	41	40	39	38	37	3.14 *
H	43	43	42.5	42.5	42	1.98 NS
K	44	44	44	43.5	43	1.82 NS
LSD value	2.75 *	2.61 *	3.05 *	2.92 *	3.16 *	---
			Body and Texture (30)			
A	27	27	26.5	26	25	2.18 NS
H	29	29	28.5	28.5	28	1.78 NS
K	30	30	30	29.5	29	1.84 NS
LSD value	2.69 *	2.72 *	2.97 *	2.81 *	3.06 *	---
			Appearance(15)			
A	12	12	11.5	11	10	2.05 NS
H	15	14.5	14.5	14	14	1.70 NS
K	15	15	15	14.5	14	1.75 NS
LSD value	2.63 *	2.86 *	2.71 *	2.66 *	2.85 *	---
			Color 10			
A	10	10	9	9	9	1.16 NS
H	9	9	8.5	8.5	8	1.06 NS
K	9	9	8.5	8.5	8	1.14 NS
LSD value	1.22 NS	1.17 NS	1.08 NS	1.18 NS	1.16 NS	---

* (P≤0.05), NS: Non-Significant.

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