Preparation low-energy yogurt fortified with pectin extracted from eggplant peels and calyxes and studying its storage capacity

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Abstract

The current study aimed to add pectin extracted from the peels and calyxes of eggplant in the manufacture of low-energy yogurt with different proportions (0.1, 0.3, 0.5) g pectin/100 ml skimmed milk, in addition to the control treatment without any addition to milk and study its effect on the chemical, physical and microbiological properties for yogurt. The value of pH and the titration acidity of the skimmed yogurt manufactured by adding the extracted pectin indicated that there were no significant differences between the control treatment (T_C) and the treatments which the extracted pectin was added immediately after the manufacturing process, while it was noted that there was a significant decrease in the pH values with an increase in the acidity values with increase in the cold storage and for all treatments. That addition of pectin extracted from eggplant peels and calyxes to skimmed milk improved the physical characteristics of yogurt, including viscosity, whey exudation and water holding capacity during refrigerated storage periods of 21 days compared to the control treatment (T_C). The total numbers of bacteria varied for the yogurt treatments with added pectin extracted from eggplant peels and calyxes, as the increase in the total numbers of bacteria decreased with increasing the storage period compared to the control treatment (TC) which increased the total numbers of bacteria with increasing the storage period. The results of the numbers of psychrophilic bacteria, yeasts and molds showed that all treatments were free of them in the first and second week of storage, and numbers began to appear in the third week of storage for the control treatment and treatment (T1) by adding (0.1) g pectin / 100 ml milk, while the numbers did not appear in the rest of the treatments (T2, T3) only on the last day of storage.The results also showed that all yogurt treatments were free of coliform bacteria, starting from the day of manufacture until the end of the 21-day storage period.

Keywords: low energy yogurt, pectin, eggplant peels and calyxes, chemical and physical properties of yogurt.

Introduction

Yogurt is defined as a food product produced by the action of starter bacteria, which is included in the combination of one or more of the following components, which are sort milk and cream, and the most important reasons that prompted the dairy industry to reduce the production of full-fat dairy and the trend to skim milk, is the consumer's awareness of the health problems that they may face when consuming fatty products, especially heart diseases (17). For this reason, skimmed yogurt has low energy and a light texture. It is also characterized by the lack of cohesion of its curd and the exudation of a large proportion of its whey; this is considered one of the major problems facing the manufacture of low-fat yogurt. Therefore, the idea of introducing pectin into the manufacture

ISSN 2072-3857

of low-fat yogurt came to compensate for the lost percentage of fat in the yogurt and improve its qualities give it a cohesive texture, stability, and the non-coarseness of the syrup, and thus reduce the problems of removing the fat for the purpose of acceptance by the consumer(12).

We can improve the skimmed yogurt through (flavor, texture and taste) by adding some stabilizers such as (pectin, starch, and inulin) to the milk that prepared for yogurt manufacturing. These thickeners work to absorb water, increase viscosity, and increase texture and cohesion. For a good yogurt that is generally accepted by consumers, but one of the common defects is the lack of cohesion of the texture in the first place, in addition to the lack of viscosity, breaking the curd and exuding in the whey, which leads to the consumer's rejection of this product (22). As these thickeners were widely used in the manufacture of skimmed yoghurt in order to reduce the intake by making the product strong in texture, in addition to reducing the phenomenon of exudation in the whey and not breaking the surface of the resulting curd (20).These stabilizers are used in the manufacture of yogurt as a thickener or thickener in order to avoid the defects mentioned previously and that most people working in this field use thickeners such as pectin, starch and inulin for yogurt as a thickener, due to its ease of use, availability in abundance and cheapness(10). Studies have shown the ability of pectin to form gels, it was used in the manufacture of skimmed yoghurt, other foodstuffs, fruit preparations, fruit drink concentrates and sweets. Most importantly, it is used as a stabilizer and thickener for skimmed yoghurt for the purpose of improving the feeling of creamy taste in the mouth and improving viscosity, sensory properties, texture and consistency (16). Therefore the study aimed to extract pectin from eggplant peels and calyxes and study the effect of adding different percentages of pectin (0.1, 0.3, 0.5) g pectin / 100 ml of skimmed milk, in addition to the control treatment without any addition to milk on the chemical, physical, microbiological and sensory properties of yogurt.

Materials and Methods

1- Chemical properties of yogurt fortified with different percentages of pectin from eggplant peels and calyxes

A- pH Estimation

The pH was determined using a pH meter at a temperature of 25°C directly on the yogurt sample after diluting it with a little distilled water before measurement according to method (4).

B- Total acidity Estimation

The acidity was estimated by addition 9 g of yogurt in a beaker and adding (2-3) drops of phenolphthalein reagent, then titrated with sodium hydroxide (0.1)N until it reached a light pink color according to method (4).

Rheological properties of yogurt fortified with different proportions of pectin from eggplant peels and calyxes

A- Estimation of viscosity

The apparent viscosity of the yogurt samples was estimated at a temperature of 10 °C and after (0, 7, 14, and 21) days of refrigerated storage, using a Brookfield pro II viscometer, as it used the axial spindle No.4, with a number of 10 cycles. minute^{-1} and with a volume of 150 ml for the sample, leave the spindle to rotate inside the sample for 60 seconds and take the reading in centipois(cP) units (7).

ISSN 2072-3857

B- Exudation of the whey Estimation

Determine the whey's exudation according to method (3), by addition 50 ml of yogurt in a cup at an angle of 45° for two hours at the temperature of the refrigerator. After that, the exuded whey was withdrawn from the surface using a syringe, and the cup was weighed again, and the process was performed within a period of 10 seconds to avoid excessive exudation.

C- Water holding capacity

The water holding capacity was estimated according to what was stated in(19) by exposing 10 g of the yogurt sample to centrifugation at a speed of 1006 x g for a period of time of 1 hour at a temperature of 10°C, after which the filtrate was isolated and the weight of the remaining wet sediment was calculated. The water holding capacity was calculated through the following equation:

Water holding capacity % = Weight of Sediment / Original Weight of Sample ✕100

2- Microbiological characteristics of yogurt fortified with different proportions of pectin from eggplant peels and calyxes.

A- Total Count of Bacteria Estimation

Take 1 g of the yogurt sample and addition to 9 ml of sterile physiological peptone solution under sterile conditions to make the first dilution $^{1-}10$ and take 1 ml of this first dilution and add to 9 ml of peptone in order to obtain the second dilution $^{2-}10$ and so on until the dilution is reached which gives an appropriate number of between(30-300) colonies of microorganisms according to the power plate count method, then 1.0 ml of the fifth and sixth dilutions were transferred separately and added to a sterile petri dish to which the culture media(N.A) was added, sterilized and cooled to 45° C by an amount of 18 ml of the media and the plate was stirred well for the purpose of spreading and homogenizing the model with the media and left to solidify. After solidification, the plates were incubated in an incubator at a temperature of 37°C for a period of (24-48) hours, after which the bacterial colonies were counted using a colony count collector and the number of colonies in the dishes was calculated and an average of three replicates were taken for each treatment. The number of colonies for each was calculated by taking the logarithm of the number of bacteria for each replicate (18).

B- Total Count of Psychrophilic Bacteria Estimation

The method described by (18) was followed in estimating the total number of psychrophilic bacteria, as 1 ml was taken from the previously prepared sample, and decimal dilutions were made, and then 0.1 ml of each dilution was transferred and cultivated on a nutrient medium of type Nutrient Agar, and then the dishes were incubated in the refrigerator temperature (7°C) for 10 days.

C- Number of Yeasts and Molds Estimation

The method that mentioned by (5) was followed, as the total number of yeasts and molds was estimated by taking 1 ml of the sample that was previously prepared, and decimal dilutions were made of it, where 0.1 ml of each dilution was transferred and cultivated in Potato Dextrose Agar culture media, and then the dishes were incubated at a temperature of 22°C for a period of 5 days.

D- Total Count of Coliform Bacteria Estimation

We followed the method (18) and used the MacConkey Agar medium to estimate the total number of coliform bacteria by the pouring method, where 1

ISSN 2072-3857

ml was taken from the previously prepared sample, and decimal dilutions were made from it, and 0.1 ml of each dilution was transferred and cultured on the media referred to above, and then the dishes were incubated at a temperature 37°C for a period of time ranging between (24-48) hours.

Results and Discussion

1- Chemical properties of yogurt fortified with different percentages of pectin from eggplant peels and calyxes

A– pH number

Table (1) shows the results of the pH values of the control treatment (T_C) yogurt, and the rest of the yogurt treatments with added pectin extracted from eggplant peels and calyxes at different concentrations (T1, T2, T3), as the value after the manufacturing process directly for the control treatment (Tc) was 4.77 and this result is higher than what they found by (8), who stated that the pH value of skimmed yogurt after the manufacturing process is 4.43. As for the amount of pH of the yogurt treatments with different concentrations of pectin extracted from the peels and calyxes of eggplant (T1, T2, T3), they were (4.80, 4.65 ,4.69), respectively, and it was also noted through the results of the same table, and after 21 days of refrigerated storage, significant decrease in pH values for all treatments by increasing the period of refrigerated storage of yogurt, and the value of the control treatment (T_C) after 21 days of refrigerated storage was (4.47) and yogurt the extracted pectin was added to it for the three treatments and at different concentrations, which reached values(4.44, 4.47, 4.43) respectively, and these results are consistent with (2) who indicated that there was a decrease in the pH values of all treatments in their study about the effect of refrigerated storage on the yogurt samples, the reason for this is due to the continued activity of the starter bacteria to break down the lactose sugar, in addition to the doubling of their numbers.

B- Total Acidity

Table (1) shows the results of the total acidity values (which were calculated on the basis of lactic acid) for the treatments mentioned above. The value of the total acidity value after the manufacturing process directly for the control treatment (Tc) was (0.83) % and this result was close to what was mentioned by (13). As for the acidity of the three different yogurt treats with added pectin extract (T1, T2, T3), it amounted to (0.82, 0.84, 0.86) %, respectively. The results of the table indicated that there was no effect of adding the extracted pectin on the acidity results compared to the control treatment (T_C) immediately after the manufacturing process. The results of the statistical analysis of the acidity results indicated that there were significant differences for all treatments with the progression of the refrigerated storage period, as the acidity of the control treatment (TC) on day 21 of refrigerated storage reached (0.89%)., while the three yogurt treats with pectin added (T1, T2, T3) they amounted to (0.87, 0.89, 0.91) %, respectively. (21) found in his study that there is a rise in acidity from (0.78) % on the first day to (0.92) % at the end of the refrigerated storage period, which is 28 days.

ISSN 2072-3857

Table 1: Chemical properties of yogurt fortified with pectin extracted from eggplant peels and calyxes at different concentrations

Treatments	Yogurt Age(day)	pH	Total Acidity
Control Treatment	0	4.77	0.83
	7	4.66	0.84
	14	4.55	0.86
	21	4.47	0.89
T1 0.1 g pectin/100 ml milk	0	4.80	0.82
	7	4.72	0.84
	14	4.45	0.85
	21	4.44	0.87
T2 **0.**3 g pectin/100 ml milk	0	4.65	0.84
	7	4.61	0.85
	14	4.56	0.87
	21	4.47	0.89
T3 **0.**5 g pectin/100 ml milk	0	4.69	0.86
	7	4.63	0.87
	14	4.51	0.89
	21	4.43	0.91
L.S.D value	———	0.0104	0.0092

2- Rheological properties of yogurt fortified with different proportions of pectin from eggplant peels and calyxes

A- Viscosity

Table(2) shows the results of the relative viscosity values of the control treatment of yogurt without any addition (T_C) and the yogurt treatments with pectin added to it extracted from eggplant peels and calyxes, as the value of the relative viscosity of the control treatment(T_C) immediately after manufacturing was 1298 centipoise, either as for the viscosity values of the three yogurt treatments (T1, T2, T3) to which different concentrations of extracted pectin were added, they increased significantly with an increase in the percentage of pectin addition, as the viscosity immediately after manufacturing reached (1643.1, 1971.1, 2253.6) centipois (cP), respectively, and it was observed

ISSN 2072-3857

through the same table, yogurt treatments with added pectin extract had superiority compared to the control treatment(T_C) free of any addition. The results in the table also indicate a significant increase in the amount of viscosity values for all yogurt treatments with the progression of the refrigerated storage period, as the viscosity value after 21 days of refrigerated storage for the control treatment(T_C) free of any addition reached (1564.8) centiPois, while the value of the viscosity of the three yogurt treatments with added pectin extracted on the 21 day of refrigerated storage(T1, T2, T3) is(1830.3, 2251.8, 2536.9) centiPois, respectively. These results agreed with what was mentioned by (21) who indicated an increase in viscosity on the 21 day of storage. The reason for this increase is due to a decrease in the pH of yogurt, which leads to an increase in its hardness, including the increase in viscosity. (14) studied the qualitative and sensory characteristics of the manufactured yogurt by adding fat substitutes, as the viscosity value of the skimmed yogurt immediately after the manufacturing process reached (1300) centipedes, and after 15 days of refrigerated storage, the viscosity value reached (1450) centiPois.

B- Whey Exudation

Table(2) shows the results of whey exudation for the control treatment yogurt and for the yogurt treatments to which pectin was added extracted from eggplant peels and calyxes, as the amount of whey exudation in the control treatment immediately after the manufacturing process was (14.46) ml/100 ml and for the three yogurt treatments with pectin added(10.7, 8.83, 6.26) ml/100 ml respectively, and it was noted through the same table a significant decrease in the quantities of whey exuded when stored in refrigerated storage, as the values after a storage period of 21 day for the control treatment reached(11.96)ml/100 ml, for the treatments of yogurt with added pectin extracted(9.10, 7.43, 4.70) ml/100 ml, respectively, the results also showed a significant decrease in the rate of whey exudation by increasing the concentration of added pectin. This means that the yoghurt fortified with pectin reduced the process of whey exudation, which led to an increase in cohesion, which increased the power of the protein network to retain water, and this is consistent with what was obtained by (6), which indicated a decrease in the whey perfusion of yogurt from 55.6% on the first day of manufacturing to 51.3% on the 21day of storage the reason is attributed to the metabolic activity of the starter bacteria and to the decrease in the net pressure inside the protein template, which led to a decrease in the whey exudation(11).

C- Water Holding Capacity

Table (2) shows the results of the percentage of water holding capacity for the control yogurt treatment and for the yogurt treatments that have different percentages of pectin from eggplant peels and calyxes. It became clear from the table that the water holding capacity of the control treatment immediately after

ISSN 2072-3857

manufacturing amounted to (47.34)%, while the water holding capacity of the yogurt treatments with added pectin (T1, T2, T3) was (51.40, 52.20, 55.31)%, respectively. The yogurt treatments with added pectin extracted were superior in their ability to hold water compared to the control treatment, as the ability to hold water increased significantly with the increase in the concentration of added pectin. It is inferred from this that the addition of pectin to yogurt increased the ability of the protein network to hold water, which increased with an increase in the refrigerated storage period, as the ability reached for the control treatment after 21 day (53.36)%, while for the yoghurt treatments with added pectin (T1, T2, T3) it amounted to(54.50, 55.10, 57.82)% respectively.

Table(2): Rheological properties of yogurt, the control treatment and the yogurt treatments with pectin added to it, extracted from eggplant peels and calyxes at different concentrations and at a temperatures of (5±1)°C, during a storage period of 21 days.

Treatments	**Yogurt Age(day)**	**Relative Viscosity(cP)**	**Whey Exudation (ml/100g)**	**Water holding capacity (%)**
Control Treatment	0	1298	14.46	47.34
	7	1487.9	13.73	49.13
	14	1543.7	12.86	51.06
	21	1564.8	11.96	53.36
T1 0.1 g pectin/100 ml milk	0	1643.1	10.70	51.40
	7	1688.7	10.06	52.31
	14	1791.5	9.60	53.11
	21	1830.3	9.10	54.50
T2 **0.**3 g pectin/100 ml milk	0	1971.1	8.83	52.20
	7	2091.5	8.43	53.61
	14	2168.7	8.06	54.41
	21	2251.8	7.43	55.10
T3 **0.**5 g pectin/100 ml milk	0	2253.6	6.26	55.31
	7	2361	5.76	56.15
	14	2485	5.13	57.25
	21	2536.9	4.70	57.82
L.S.D value	———	0.495	0.137	0.074

*Each number represents an average of three replicates

ISSN 2072-3857

3- Microbiological properties of yogurt fortified with different proportions of pectin from eggplant peels and calyxes.

Table (3) shows the results of estimating the total number of bacteria, the number of coliform bacteria, psychrophilic bacteria and the total number of yeasts and molds for the control treatment yogurt and the yogurt treatments with pectin added from eggplant peels and calyxes (T1, T2, T3) at different concentrations mentioned above, immediately after the manufacturing process, and during refrigerated storage at a temperature of (5 ± 1)°C for a period of 21 day. It was noted that the total number of bacteria immediately after the manufacturing process for the control treatment amounted to (8.26) logarithmic cycles.(1) indicated that the total number of bacteria in the yogurt amounted to 60 $x^7$10 cfu/g. As for the yogurt treatments with added pectin extracted from eggplant peels and calyxes (T1, T2, T3) immediately after the manufacturing process, so the total number of bacteria was (8.13, 8.04, 7.52) logarithmic cycle, respectively. The results of the same table also showed a significant increase in the value of the total number of bacteria for the control treatment with the progression of the refrigerated storage period, as its value on the 21day of storage reached (8.83) logarithmic cycles, as for the treatments of yogurt with added pectin extract (T1, T2, T3) on the 21st day of refrigerated storage, they reached (7.94, 7.85, 7.89) logarithmic cycle, respectively.Through these results referred to in the table, we notice a significant decrease in the total number of bacteria for the yogurt treatments to which pectin is added extracted from eggplant peels and calyxes, the reason may be attributed to the inhibitory ability of pectin against some microorganisms that may have an effect on the activity and growth of microorganisms during refrigerated storage (9) .

The results of the same table showed that the control treatment for yogurt and the treatments with added pectin extracted from eggplant peels and calyxes were free of coliform bacteria in all refrigerated storage periods, and this is expected as a result of the high heat treatment during the yogurt manufacturing process, so the numbers of the control treatment on day(0,7) were devoid of Psychrophilic bacteria, while bacterial growth began to appear on day 14, which reached (7.22) logarithmic cycle, and increased on day 21, when the numbers reached (7.31) logarithmic cycle, respectively. For the yogurt treatments with added pectin extract, the results

ISSN 2072-3857

indicated that treatment T1 was free of any bacterial growths on day 0 and 7 days of storage, then the numbers appeared on day 14 as it reached (6.61) a logarithmic cycle and increased to (7.25) a logarithmic cycle on day 21 from the refrigerated storage. The same table indicated that the treatment (T2, T3) was free from the growth of psychrophilic bacteria on days (0, 7, 14), while on the 21st day of the refrigerated storage, the numbers appeared in the treatment T2 and reached (7.06) a logarithmic cycle, while it reached for treatment T3(6.70) logarithmic cycle. Through these results, we notice that the pectin extracted from the peels and calyxes of eggplant added to the yogurt reduced the number of psychrophilic bacteria. As for the total number of yeasts and molds for the control treatment, the results of the table indicated that the treatment was free of yeasts and molds on days (0,7), while it began to appear in days (14, 21), which amounted to (7.15, 7.32) logarithmic cycles, respectively, while the results indicated that treatment (T1) was also free of any growth of yeasts and molds in days(0,7) and also began to appear in days (14, 21), which amounted to (7.62, 7.82) logarithmic cycles, respectively.

As for the treatments T2 and T3, the results of the table indicated that they were free from yeasts and molds on days (0, 7, 14) and appeared on the 21st day of the refrigerated storage, in which the numbers reached (7.13, 6.16) logarithmic cycle, respectively. Through the results, a significant decrease is observed in the numbers of yeasts and molds for the treatments to which pectin was added compared to the control treatment, the reason may be attributed to the presence of effective compounds in the extracted pectin that led to a decrease in these numbers (15).

ISSN 2072-3857

Table (3): Microbial tests of yogurt, the control treatment and the yogurt treatments with pectin added to it, extracted from eggplant peels and calyxes at different concentrations and at a temperatures of (5±1)°C, during a storage period of 21 days.

Treatments	Yogurt Age(day)	Total number of bacteria	Coliform Bacteria	Psychrophilic Bacteria	Yeasts and Molds
Control Treatment	0	8.26	0.0	0.0	0.0
	7	8.41	0.0	0.0	0.0
	14	8.72	0.0	7.22	7.15
	21	8.83	0.0	7.31	7.32
T1 0.1 g pectin/100 ml milk	0	8.13	0.0	0.0	0.0
	7	7.82	0.0	0.0	0.0
	14	7.87	0.0	6.61	7.62
	21	7.94	0.0	7.25	7.82
T2 **0.**3 g pectin/100 ml milk	0	8.04	0.0	0.0	0.0
	7	7.72	0.0	0.0	0.0
	14	7.82	0.0	0.0	0.0
	21	7.85	0.0	7.06	7.13
T3 **0.**5 g pectin/100 ml milk	0	7.52	0.0	0.0	0.0
	7	7.62	0.0	0.0	0.0
	14	7.75	0.0	0.0	0.0
	21	7.89	0.0	6.70	6.16
L.S.D value	———	0.0361	0.0218	0.0218	0.0330

Conclusion

The results of the study indicated that it is possible to extract pectin from the peels and calyxes of eggplant and use it in the manufacture of fat- free yogurt as a substitute for fat, as the pectin extracted improved the physical properties of the fat-free yogurt, including its ability to hold water and reduced the whey's Exudation

References

1. **Al-Bedrani ,Dhia Ibrahim Jerro. 2016**. Manufacturing low-energy dairy products using non-fat alternatives. Fatmimetics and studying their physicochemical and nutritional properties. PhD thesis - College of Agriculture - University of Baghdad.
2. **Alting, A. C.,V.Fred.,and M.Kanning .2009**. Improved creaminess of low-fat yoghurt:

ISSN 2072-3857

The impact of amylomaltase-treated starch domains.Food Hydrocolloids .23(3):980 - 221.

3. **Amatayakul, T.; F.Sherkat and Shah , N. P. 2006**. Syneresis in set yogurt as affected by EPS starter cultures and levels of solids. Int. J. Dairy Tech. 59. 216–221.
4. **AOAC. 2008.** Official method of analysis 13th ed., Washington Dc. Association of Official Analytical Chemists. https://doi.org/10.1016/j.foodchem.2008.02.062
5. **APHA (American Public Health Association) .1984.** Compendium of methods for microbiological examination of foods. (2nd ed.), M.L. Speek (ed). Washington, D.C.
6. **Çelik, E.S.2007 .** Determination of aroma compounds and exopolysaccharides formation by Lactic acid bacteria isolated from traditional yogurts. Thesis :MSc Thesis in Bio. Izmir University. https://doi.org/ 10.11618/zjar.2007.42579
7. **Donkor O.N.; S.L.I.; P. Nilmini; V. T. Stolic;asiljevic. and Shah N.P., 2007**. Survival and activity of selected probiotic organisms in settype yoghurt during cold storage. Int. Dair https://doi.org/10.1016/j.idairyj.2006.08.006
8. **El-Galeel, A., Ali, A., Atwaa, E. H., & Abdelwahed, E. M. 2017.** Improving Properties Of non-Fat Yoghurt Using Fat Replacers. Zagazig Journal of Agricultural Research, 44(2), 583-590 https://doi.org/ 10.21608/zjar.2017.53878.
9. **Fernondez G. E. and J. U. MC Gregor, 1997**. Fortification of yoghurt with insoluble dietary fiber. Zeitsch Ieben Smittel Und-Forschung A. 204 (6) 433-437.
10. **Foss, J. W. 2000.** How processing affects starch selection for yoghurt. Bridgewater, NJ: National Starch and Chemical Company
11. **Guler-Akın, M.B., and Akınm S.M. 2007.** Effects of cysteine and different incubation temperatures on the microflora, chemical composition and sensory characteristics of bio-yogurt made from goat's milk. Food Chem. 100:788-793. https://doi.org/10.1016/j.foodchem.2005.10.038
12. **Guven ,M.,Yasar,K.,Bkaraca,O.and Hayal;gu,A.A. 2005.**The effect of Inulin as a fat replacer on the quality of set -type Low-fat yoghurt manufacture .Inter.J.of Dairy Tech.58:180-184. https://doi.org/10.1111/j.1471-0307.2005.00210.x
13. **Hamid T, FaridehV, FahimehJ,. 2014.** Textural and sensory Propertise of low fat concentrated flavored yogurt by using modified waxy corn starch and gelatin as a fat replacer. International Journal Of Biosciences. ISSN: 2220-6655. Vol. 5, No. 6, P: 61-67.http:/dx.doi.org/10.12692/ijb/5.6.6.1-67
14. **Hussein, Feryal Farouk and Nour, Juma Fadel. 2017.** A study of the characteristics and sensory characteristics of yogurt with some fat substitutes, Al-Anbar Journal of Agricultural Sciences 15, (a special issue on pomegranates): 499-507.
15. **International Dairy Federation.2003**.Yoghurt :Food

enumeration of characteristic microorganisms - colony count technique at 37 C°.IDF Standard No 117 E,Brussels.

https://doi.org/10.1016/j.idairyj.2003.10.010

16. **Kip,P.,Meyer,D.and Jellema,R.H.2006** .Inulins improve sensory and texture properties of low-fat yoghurt.Int.Dairy.J.16:1098-1103
17. **Loveday,S.M.,A.Sarkar,and H.Sing.2013**.Innovative yoghurt:novel processing technologies for improving acid milk gel texture .food chem.87:501–542. https://doi.org/10.1016/j.tifs.2013.06.007
18. **Moghimi.N.; A.Khanjasi. and N.B.Mogadam. 2017**. Effect of Whey protein isolate coating enriched with Black cumin essential oil and lysozyme on tjhe shell-life of chicken fillets during Refrigerated storage. International Journal of Food Nutrition and Safety,8(1):32- 44. https://doi.org/10.1106/j.tifs.2017.06.017
19. **Parnell-Clunies ,E.M.; Y. Kakuda.; K.Mullen.; D.R. Arnot .and DeMan, J.M. 1986**.Physical properties of yogurt: A comparison of vat versus continuous heating systems of milk. J Dairy. Sci. 69:2593-2603. https://doi.org/10.3168/jds.S0022-0302(86)80706-8
20. **Phillips, G. O. and Williams, P. A. 2009.** Handbook of hydrocolloids. Second edition, Woodhead Publishing India Private Limited, G-2, Vardaan House, 7/28 Ansari Road, Daryaganj, New Delhi - 110002, India-1313.
21. **Shaghaghi, M.; Pourahmad, R. and Mahdavi ,A.H.R. 2013.** Synbiotic Yogurt Production by Using Prebiotic Compounds and Probiotic Lactobacilli. Int . Res J. of Applied Basic Sci.5(7): 839-846. http://irjabs.com/files_site/paperlis.
22. **Stigepic, M., J. Glusac; and D. Durdevic, 2013**. Physicochemical characteristics of soy probiotic yoghurt with inulin. Romanian Biotech Lethers, 18(2) https://doi.org/ 10.11601/zjar.2013.73875

ISSN 2072-3857