Effect of Supplementation with Watermelon Seeds Pulp on Characteristics of Set -Yogurt as A Natural source of Iron

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ABSTRACT

The aim of this study was to evaluate the effect of supplementation of different ratio of watermelon seeds on the physciochemical, rheological and sensory properties of set yogurt. The Yoghurt was supplemented with watermelon seeds (*Citrullusl anatus*), in different ratio (T1) 3%, (T2) 5%, (T3) 10% and (T4) 15% were compared with control. The addition of watermelon seeds had a significant effect on pH values and acidity% of different yoghurt samples. Increasing of seeds ratio increased iron content, T.S, via protein content .Also the viscosity was increased as the percentage of ratio of seeds increased .sensory properties of all fresh samples had the best score and accepted after 3 and 10 days of storage. Results indicated that watermelon seeds consider as a good source of nutrients in the diet and may have health and economic benefits due to its content of fiber, minerals and a great effect of antioxidant activity.

Keywords: Set-Yogurt, Iron Deficiency, *Watermelon seeds pulp*.

INTRODUCTION

Yogurt is one of the most popular fermented dairy products worldwide which has great consumer acceptability due to its health benefits other than its basic nutrition.It is a good source of proteins, fats and carbohydrates as well Vitamins and calcium .However, it is a generally bad source of rare elements, metal traces such as iron, zinc and copper are particularly important among milk voters. (Mckinley, 2005; Ndife et al., 2014; Oladipo et al., 2014).

Iron deficiency anemia may cause stunted growth, impaired mental development, poor school performance, reduced productivity, increased morbidity and mortality, and lower self-esteem Food fortification with iron has been recommended as one of the preferred approaches for preventing and eradicating iron deficiency. However, fortification with bioavailable iron sources often presents multiple (Woestyne et al., 1991).

Supplementation with iron is technically more difficult than with other nutrients because iron reacts chemically with several food ingredients. Therefore, the ideal iron compound for food fortification should supply highly bioavailability iron, it should not affect the nutritional value or sensory properties of the food, it should be stable during food processing and finally it should have low cost (Hekmat and McMahon, 1997).

Watermelon (Citrulluslanatus) a fruit crop, is a herbaceous creeping plant belonging to the family cucurbitaceae. It is mainly propagated by seeds and thrives best in warm areas. It is a tropical plant and requires a lot of sunshine and high temperature of over 25°C for optimum growth. Watermelon thrives best in a drained fertile soil of fairly acidic nature. It can be grown along the coastal areas of Ghana, the forest zone and especially along river beds in the Northern Savannah areas. Watermelon seeds are known to be highly nutritional; they are rich sources of protein, vitamins B, minerals (such as magnesium, potassium, phosphorous, sodium, iron, zinc,manganese and copper) and fat among others as well as phytochemicals (Braide et al., 2012).

Watermelons seeds are known to have economic benefits especially in countries where cultivation is on the increase. The seeds are for instance used to prepare snacks, milled into flour and used for sauces. Oil from the seeds are used in cooking and incorporated into the production of cosmetics (Jensen et al., 2011). In spite of the various potential applications, the watermelon seeds are often discarded while the fruit is eaten. There is also limited literature on the effect of varieties on the nutritional, phytochemical and antioxidant properties of the watermelon seeds. In this study, theproximate and antioxidant activity were determined in theseeds of three of watermelon varieties. The seeds were also screened for the presence of some phytochemicals andminerals content (Tabiri et al., 2016).

The aim of the present investigation was to evaluate the feasibility of using watermelon seeds pulp as enriching in iron content and to study sensory, physico - chemical properties of the functional set- Yogurt

MATERIAL AND METHODS

Materials

Full fresh cow's milk obtained from local market,(12.1%TS,3.1% fat and 3.5% protein). Skim milk powder was obtained from Rucker company, Germany(Fat 1.5%, Pro. 32%, Lactose less than 53%, Moisture(3.5)% and ash7%. Culture preparation: culture freeze- dried lactic culture for direct vat

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set(DVS) (Express 0.2, thermophilic yoghurt culture YO-Flex Express).consisting of *Lactobacillus delbrueckii ssp. bulgaricus* and *Streptococcus thermophilus* for manufacture of yoghurt was obtained from Chr. Hansen's lab., Denmark .

Methods:

Preparation of watermelon seeds Pulp (WSP): Watermelon seeds were obtained from a local market, then the husk was removed from the seeds and the seeds were roasted through a drying oven for (3 -4)hours at 50°c the seeds were also ground using an electric grinder to be ready for use Abd El-Sattar et al. (2021). Seeds of watermelon were analyzed for their minerals, Phytochemicals, and antioxidant activity. The present findings suggest watermelon seeds as considerable source of nutrients in the diet and may have health and economic benefits due to its fiber, minerals and antioxidant activity.

Table 1. The chemical composition of watermelon seed pulp

Chemical composition	W.S.P
Moisture %	8.6 %
Protein %	31.6%
Ash %	4.09%
V.C %	2.2%
Iron%	6.2 %

Preparation of set-Yogurt :Fresh full cow milk was fortified with 3% Skim Milk Powder. Therefore divided into five equal portions. Five treatments were carried out.The first treatment is yoghurt with no additive (acontrol); in the second, third , fourth and fifth treatments 3% ,5%, 10% and 15% of watermelon seeds pulp were added and mixed with cow's milk respectively. And Both Control and Yoghurt samples were cooled and stored in a refrigerator at (4°C) for 14 days for further analysis. Yogurt was manufactured according to the protocol proposed by Tamime and Robinson (1999).

Determination of Chemical Composition: All the Yogurt samples were analyzed in triplicate for Titratable Acidity, protein, ash, moisture and total solid content by using the method of AOAC (AOAC, 2005). The pH value of milk and yogurt was measured using Lab. pH meter JENWAY-3505.

Wheying Off The amount of separated from yogurt samples was measured after keeping the yogurt bottles for the storage time in the refrigerator. The separated upper layer of whey was collected by means of syringe. The amount of collected whey was measured using a graduated cylinder (Hatem, 1996).

Viscosity:It was determined by using a digital Brookfield Viscometer (Model LVDV-E, Brookfield Engineering Laboratories, Inc. USA)according to Atherton and Newlander (2000).

Iron content: Iron was determined using Atomic Absorption Spectrophotometer, Pyeunican SP 1900 , according to Jones et al. (1991).

Sensory evaluation : Sensory evaluation of yoghurt samples was performed at fresh , 3,10 and after14 days of storage. group of panelists consisting of 10 members from department, Animal Production Research Station, Al-Gemmaiza and some consumers the yoghurt samples presented in coded cups inside the individual booths at room temperature. Sensory score with degrees of intensity of yoghurt attributes such as appearance, color, texture, flavor, and overall acceptance was used. Scoring was performed according to Mohamed et al. (2014).

Statistical Analysis :Statistical analysis was performed by using two way analysis of variance (SPSS) and themeans were compared across groups by Tukey test. All analyses were carried out in triplicate. Results were analyzed with the Origin Pro 8 and the significant differences were determinedat ($p \leq 0.05$).

RESULTS AND DISCUSSION

Total solid content(TS) : Data in Table 2 Showed that slight increase in total solids of the yoghurt was occurred as a result of using watermelon seeds pulp(W.S.P), as the percentage of W.S.P increased ,the total solid of yogurt increased .There are significant differences between control and the four level of W.S.P. for the T.S. On the other hand from statistical analysis, there aren't significant differences foundin T.S was observed as the storage period progressed.These results are in agreement with those reported by Biliaderis et al. (1992) and Lee and Lucey (2010), similar results were obtained by Samadrita et al.(2014), who reported that T.S. content The total solid determined was significantly high ($p \leq 0.05$) in WJY(Abd El-Sattar et al., 2021).

Titratable acidity : Table (3) shows that acidity values in set- yogurt was gradually increased in the treated samples as compared with the control during storage period.There is a significant difference for acidity between fresh control(.98 ±0.12) and the four treatments of W.S.P for 14 days old yogurt. Also Acidity gradually increases with increasing percentages of WS%(.85 ±0.10). These results are in agree with those reported by Alomery (2010), who studied that the storage period of different levels of watermelon seeds powder had significant ($P<0.05$) effect on titratable acidity of yoghurt samples.During storage, acidity of yogurt was increased due to the conversion of lactose into lactic acid. Similar trend were reported by Murtaza et al. (2004).

Table 2. Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the T.S% at fresh and during storage period

treats	Storage period				
	fresh	3	9	14	Total
C	12.04±.519	12.05±.52	12.05±.52	12.10±.61	12.06±.46 c
T1	12.45±.66	12.46±.66	12.53±.70	12.54±.71	12.49±.58 bc
T2	12.70±1.33	12.70±5.52	12.71±.47	12.73±.32	12.53±2.46 bc
T3	13.42±.41	13.43±.41	13.45±.40	13.51±.36	13.45±.34 ab
T4	13.86±.64	13.88±.63	13.90±.62	13.93±.61	13.89±.53 a
Total	12.89±.99 A	12.90±2.25 A	12.92±.83 A	12.96±.87 A	12.88±1.34

(a,b,c…etc) Means at the same row with different superscripts are different by Duncan's multiple comparison tests.
(A,B,C…etc)Means at the same column with different superscripts are different by Duncan's m
ltiple comparison tests.
C=yogurt mad from caw's milk without any addition
T1,T2,T3 and T4 =Yogurt made with 3%,5%,10%and 15%of watermelon seeds pulp respectively.

Table 3.Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Acidity % and pH value at fresh and during storage period

Parameters	Storage period	Treatments					Total
		C	T1	T2	T3	T4	
Acidity%	**Fresh**	0.84±0.01	0.77±0.00	0.78±0.01	0.79±0.01	0.82±0.02	0.80±0.02 C
	3.Days	.95± 0.06	.78±0.00	.79±0.01	.81±0.06	.84±03	.83±0.07 BC
	9 D.	4.21±.11	.78±0.00	.80±0.00	.87±0.10	.84±0.01	.87±0.11 AB
	14 D.	3.97±.07	.78±0.01	.88±0.12	.91±0.12	.91±0.10	.91±0.13 **A**
	Total	4.20±.21 **C**	.78 ±0.00 **c**	.81±0.06 **bc**	.84 ±0.12 **b**	.85 ±0.05 **b**	.85 ±0.10
pH value	**Fresh**	4.33±.28	4.29±.00	4.31±.03	4.4±.06	4.52±.02	4.38±.14 **A**
	3.Days	4.29±.17	4.26±.05	4.26±.04	4.36±.05	4.47±.03	4.33±.1 **AB**
	9 D.	**4.21±.11**	**4.23±.05**	**4.26±.04**	**4.33±.04**	**4.42±.02**	**4.28±.09 B**
	14. D.	3.97±.07	4.23±.05	4.20±.03	4.28±.03	4.39±.01	4.21±.14 **C**
	Total	4.20±.21 **C**	4.25±.05 **C**	4.25±.05 **C**	4.36±.08 **b**	4.45±.05 **a**	4.30±.13

The effect of addition of watermelon seeds on the pH value is presented in(Table **3**). The pH was differed significantly ($p<0.01$) among different treatments and during storage period. Set-Yogurt (T4) had the highest pH value, however © had the lowest value comparing with other treatments. The results of the current research are in close agreement with the findings of Lopez et al. (2012). pH value for storage period decreased from 4.38 ±.14 to 4.21±.14 at fresh and 14 days respectively. This decrease in pH during storage might to due to increasing acidity. Murtaza et al. (2004) and Alomary (2010),who revealed that the storage period and different levels of watermelon seeds powder had significant ($P<0.05$) effect on the pH value yoghurt sample

Table 4.Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Protein content at fresh and during storage period

treats	Storage period				
	fresh	3	9	14	Total
C	2.7150±.51135	2.7543±.43594	2.9300±0.20226	2.9983±0.22485	2.8509±0.33795 d
T1	3.8167±0.3946	3.8177±0.04028	3.8187±0.03937	3.8930±0.11588	3.8365±0.06681 cd
T2	3.9317±0.17404	4.0030±0.18518	4.1290±0.26241	4.1930±0.30612	4.0642±0.22974 bc
T3	4.1323±.55194	4.2950±0.66661	4.3293±0.70502	4.5256±0.52712	4.3206±0.54626 ab
T4	4.3377±0.70897	4.4323±.68599	4.5337±.62827	4.8300±.73655	4.5334±.62014 a
Total	3.7867 A	3.8605 A	3.9493 A	4.0880 A	3.9207

Protein contents: protein content in table (**4**)of samples were significantly affected ($p < 0.01$) due to different concentrations of water melon seed pulp(W.S.P) in yogurt. The protein contents for all the treatments were in the range of ($3.83\% \pm 0.06\%$) to ($4.53\% \pm 0.62\%$). Watermelon seed supplementation increased the protein content significantly as compared to the control (*C*). On the other hand during the storage period there aren't significant difference between control and other treatments.Similar results were stated by Tabiri et al. (2016),who reported that watermelon seeds had high protein content.

The ash content: The ash contents of different treatments of yogurt samples are shown in Table (**5**). The lowest ash contents were observed in control sample while the other treatments of yogurt supplemented with W.S.P resulted in increasing the ash contents significantly. Ash content increased as the proportion of (W.S.P) increased among different treatments and during storage. This could be due to the fact that (W.S.P) der has high ash content and minerals (Tabiri et al., 2016).who reported that watermelon seeds contained ash content. The highest value was noticed in yogurt supplemented with 15% (W.S.P) and the lowest value was given for the control. The high ash content in yogurt supplemented with (W.S.P) agree with the results obtained by Akalın et al. (2018), who shows the significant increasing in ash content with increasing ratio of supplementation with watermelon seeds, similar trends were observed by Junior and Lannes (2011).

In Table (6) presented that yogurt supplemented with W.S.P caused a high significant increase in the viscosity, and this increasing was proportional to the supplementation ratio ,There were relationship between increasing in T.S content of milk and the increasing of viscosity of set-yogurt treatment (Wacher-Rodarte et al., 1993). The viscosity of yoghurt or perceived thickness also increases with an increase in total solids content of milk (Sodini et al., 2004).Similar results were observed by Abd El-Sattar et al. (2021)who presented that supplementation of ice milk with (WSELP) caused a significant increase in the viscosity compared with control treatment, and this increasing was proportional to the supplementation ratio.

From Table (7) it is clear for all treatments as the storage time progressed the wheying off increased for control. While in another treatments, the wheying off was not observed during the storage period except for T1,the wheying off was observed at the end of the storage period only. This is might due to increase total solids in other treatments which effects on the water holding capacity. A high level of W. S.P minimize the serum separation form continues interconnected network that entrap water in yoghurt (Fiszman and Salvador, 1999).

Data presented in table(8) showed that there are significant differences between control and the other four treatments.

Table 5. Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Ash content at fresh and during storage period

Treats	Storage period				
	fresh	3	9	14	Total
Con	1.01±.01	1.00±.00	1.10±.13	1.33±.12	1.11±.16
T1	2.89±.09	2.88±.08	2.85±.05	2.85±.05	2.87±.06
T2	3.02±.04	3.05±.09	3.07±.08	3.10±.10	3.06±.07
T3	3.25±.08	3.26±.08	3.28±.07	3.35±.18	3.28±.10
T4	3.41±.06	3.42±.07	3.43±.07	3.50±.17	3.44±.09
Total	2.71±.90	2.72±.91	2.75±.88	2.82±.81	2.75±.85

Table 6. Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Viscosity at fresh and during storage period

Treats	Storage period		
	fresh	14	Total
Con	2225±7.0	2205 ±7.07	2215±12.90**e**
T1	3165 ±7.0	2780 ±14.1	2972.5±222.4**d**
T2	3210±14.1	3315±21.2	3262.5±62.38**b**
T3	3285±7.0	3655±7.0	3470±213.69**a**
T4	3325±7.0	3155±7.0	3240±98.31**c**
Total	3042±434.6	3022±522.9	3032±468.12

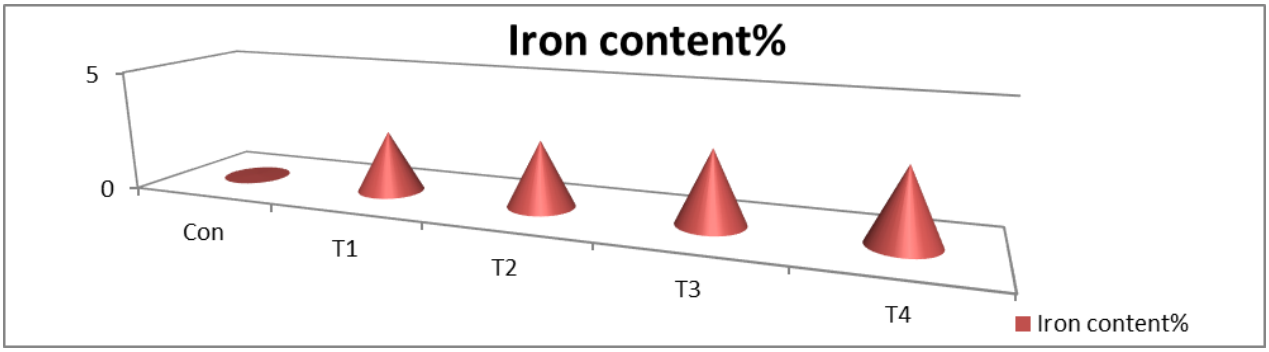
Table 7. Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Wheying off

Treats	Storage period			
	3	**7**	**9**	**14**
Con	1.109	1.940	2.584	2.924
T1	0.000	0.000	0.000	.521
T2	0.000	0.000	0.000	0.000
T3	0.000	0.000	0.000	0.000
T4	0.000	0.000	0.000	0.000

Table 8. Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Iron content

	C	**T1**	**T2**	**T3**	**T4**	**Total**
Iron %	.040 ± .05 **d**	2.53±.02 **c**	2.71±.06 **b**	2.98±.012 **a**	2.99±.00 **a**	2.25±1.16
DRI %	0.4%	25.3 %	27.1%	29.8%	29.9%	22.5%

DRI: Dietary Reference Intakes



By increasing the percentages added from W.S.P the percentages of iron in the yoghurt increase accordingly, as the highest value was (2.9963±.005) for T4 and the lowest value was (.0400±.05.) for control. These results were similar to Braide et al. (2012).

Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Microbiological properties: The obtained counts in the different media revealed that all samples analyzes where free of microbial count. The absence of bacteria and other microorganism in the samples can be due to an efficient heat treatments and good sanitation conditions applied during manufacture and throughout storage.

On the other hand the absence of lactic **acid** bacteria in the different samples is probably due to the fact that the (Tryptic Glucose yeast Agar) does not contain the necessary mutants important for their development, The same trend was reported by Amer (2018).

Sensory evaluation : The summary of the sensory evaluation of control yogurt and yogurt treatments done by judgers are shown in Table (9) .sensory evaluation of different yogurt as affected by the supplementation of W.S.P

Appearance: The supplement of W.S.P to the yogurt at the rate of 10%, 15% improved the appearance of the yogurt were the yogurt became homogeneous and low in wheying off . At the end of storage period the appearance of all treatments gained less scoring points.

Flavor: Results revealed that in the fresh and during the storage period yogurt supplemented with W.S.P at the rate of 10% had the highest value when compared with control and the other treats.

Texture :results showed that set-yogurt (T3) had the highest score at fresh and after 10 days when compared with other treatments.

Table 9. Effect of supplement set-yoghurt with different ratio of watermelon seeds pulp on the Sensory properties at fresh and during storage period

Treats	Storage period	Appearance	Flavor	Texture	Consistency	Overall acceptable
C	Fresh	8.67±.57	7.6±.57	8.00±1.00	8.00±1.0	8.00±0.00
	7	7.66±.57	7.0±0.00	7.33±.57	7.00±0.0	7.66±.57
	14	6.66±.57	6.67±.57	6.66±.57	7.00±0.0	6.33±.57
	total	7.66±1.00 B	7.1±.60 B	7.33±.86 B	7.33±.70 AB	7.33±.86 B
T1	Fresh	8.00±1.0	8.0±1.0	8.66±.55	8.33±.57	7.66±1.15
	7	7.33±.57	7.0±0.0	8.33±.57	6.6±.57	7.66±.57
	14	6.33±.57	6.33±.57	7.50±1.00	5.66±.57	6.33±.57
	total	7.22±.97 B	7.11±.92B	8.0±1.00 B	6.55±.88 B	7.22±.97 B
T2	Fresh	9.00±0.00	9.00±0.0	8.8±.577	9.00.±0.0	8.52±.57
	7	8.83±.57	8.53±.57	8.66±.57	8.5±.57	8.55±0.0
	14	8.00±.57	8.00±.57	8.55±.57	8.00±0.0	8.00±.57
	total	8.61±.83 A	8.51±.83 A	8.67±.60 AB	8.5±.52 A	8.35±.60 A
T3	Fresh	9.00±1.0	9.03±.57	9.5±.57	9.00±.57	8.95±0.0
	7	9.00±0.00	8.53±.57	9.07±.57	8.5±.57	8.5±.57
	14	8.56±.57	8.0±0.0	8.5±0.00	8.00±0.0	8.5±0.0
	total	8.53±.88 A	8.52±1.01 A	9.02±.8 A	8.50±.86 A	8.65±.92A
T4	Fresh	9.00±0.00	8.00±.57	9.00±.57	8.0±1.00	8.00±1.15
	7	8.55±0.00	8.00±.57	8.50±.57	7.3±.57	8.00±.57
	14	8.30±1.15	7.00±.57	8.00±.57	7.00±.57	7.33±.57
	total	8.61±.83 A	7.66±.88AB	8.50±.78 AB	7.43±.97 AB	7.77±.8 AB
Total	F	8.73±.72 a	8.32±.59 a	8.79±.74 a	8.46±.73 a	8.22±.70 a
	7	8.27±.48 b	7.81±.41 b	8.37±.79 b	7.58±.5 b	8.07±±.5 a
	14	7.57±.79 c	7.20±.50c	7.84±.63 c	7.13±.56 c	7.29±48 b
	total	8.12±.94	7.78±.84	8.30±.90	7.66±.84	7.86±.8

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الملخص العربي

تاثير تدعيم اليوغورت بلب بذور البطيخ كمصدر طبيعى للحديد

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الهدف من هذه الدراسة هو تقييم تأثير إضافة نسب مختلفة من بذور البطيخ على الخواص الفيزيائية والكيميائية والريولوجية والحسية للزبادي. تم تدعيم الزبادي ببذور بطيخ (Citrullusl anatus)بنسب مختلفة3(T1) ٪ ، 5 (T2)٪ ، 10 (T3)٪ و15 (T4) ٪ .و المقارنه مع الكونترول . إضافة بذور البطيخ كان لها تأثير معنوي على قيم الأس الهيدروجيني ونسبة الحموضة لعينات الزبادي المختلفة. أدت زيادة نسبة البذور إلى زيادة محتوى الحديد ، الجوامد الصلبه الكليه وكذا قيم البروتين ، كما زادت اللزوجة مع زيادة نسبة البذور ، كما اظهرت هذه العينات عدم طرد الشرش خلال فتره التخزين بزيادة النسب المستخدمه، وحصلت الخواص الحسية لجميع العينات الطازجة على أفضل درجة وتم قبولها بعد ٣ و ١٠ أيام من التخزين. أشارت النتائج إلى أن بذور البطيخ تعتبر مصدرًا جيدًا للعناصر الغذائية في النظام الغذائي وقد يكون لها فوائد صحية واقتصادية نظرًا لمحتواها من الألياف والمعادن وتأثيرها الكبير كمضاد للأكسدة.