1- Quality properties of Husk Tomato Juice and its impact In Stirred Probiotic Yogurt

Eman M. Hegazy[1,] **Afaf O. Ali**[2], **Hoda Samir El-Sayed**[3,] **Jihan M. Kassem**[* 3]

1- Food Toxicity and Contaminants Department, Food Industries and Nutrition Division, National Research Centre, 33thBuhouth Street, Dokkii, Giza, Egypt Postal Code 12622.
2- Regional Centre of Food and Feed, Agriculture Research Center, Giza, Egypt.
3- Dairy Department, Food Industries and Nutrition Division, National Research Centre, 33thBuhouth Street, Dokkii, Giza, Egypt Postal Code 12622.

ABSTRACT: Background: Thinking about something new that is important for consumer health is a great concern to all those interested in the dairy industry and its products. Husk Tomato is a promising nutritious fruit rich in minerals, vitamins, and antioxidant compounds. **Aim:** The objective of this study is to evaluate Husk Tomato Juice (HTJ) constituents, its antimicrobial activity and antioxidant properties. Then utilize it for producing stirred probiotic yogurt (SPY) as a novel fermented product. **Methodology:** The main components and sugars of fresh HTJ were analyzed using High Performance Liquid Chromatography (HPLC). Antioxidant activity by DDPH (2, 2-diphenyl-1picrylhydrazil) test as well as total phenolic compounds were also determined. Four treatments of SPY fortified with 20, 30, 40 and 50% (v/v) HTJ & *Lb. casei* FEGY9973 (as probiotic bacteria) were prepared and served as T_1, T_2, T_3 and T_4 respectively were compared against control without juice. **Results:** Data revealed that the main compounds of HTJ were Sinapic (8.170µg/ml), Protocatechuic (6.344 µg/ml) and Cinnamic (4.660 µg/ml). Contents of Fe, Mg, Na and Ca were 1.766, 1.627, 7.436 and 12.14 mg/100 g. Antioxidant activity and total phenolic compounds of fresh HTJ were 68.88% and 319.15 ppm respectively. It was found that HTJ had powerful antimicrobial activity against both of *Y. enterocolitica* and *Ent. faecalies*. On the other hand, data revealed that the antioxidant activity of fresh SPY samples were significantly ($p<0.05$) higher 67.66, 76.93, 69.34 and 69.59% for T_1, T_2, T_3 and T_4 in order, compared to control sample (66.57%). While, appearance scores had no significant ($p>0.05$) for all samples in fresh, 5 and 10 days of storage. All treatment samples possessed acceptable sensory properties. **Conclusion:** It could be conducted that SPY fortified with 20 and 30% HTJ had been successfully produced as a healthy dairy product.

Key Words: Husk Tomato Fruit, Probiotic bacteria, Minerals content, Antioxidant activity, Stirred yoghurt, Sensory evaluation.

Telephone:+20233371635- 33370933.
Fax: +20233370931.
***Corresponding Author**: jihankassem997@gmail.com.

INTRODUCTION:

Nowadays, consumers are gradually shifting towards the consumption of natural fruit juice-based-beverages because of their high nutritional values, medicinal importance, and good calorific source over synthetic beverages **(Ramadan and Mörsel, 2011 & Hemalatha *et al.,* 2018).** Many countries through the world have been detected the magnitude of fermented food as a cheap means of preservation, promoting nutritional quality and consolidating sensory characteristics **(Marsh *et al.*, 2014)**. Phenolic compounds also had a global attention recently due to antioxidant, anti-inflammatory, anti-mutagenic and anti-clotting power which has been correlated with a declined risk of cardiovascular diseases and cancer development (**Jalal *et al.,* 2016).** Husk tomato (*Physalis peruviana, L.*) is an auspicious fruit which known also as golden berry, cape gooseberry, tomatillo and ground cherry are gaining publicity in various markets and regions. In Egypt, economical importance of *Physalis* is increase, for achieving a major success in local, Arabic and European markets. Furthermore, It is given a considerable attention for promoting this hopeful crop; production and quality to meet the gradual request of local fresh markets, medicinal purposes, developing processing industry **(El Sheikha, 2004, Mustafa, 2009 and Hemalatha *et al.*, 2018).** It has potential medicinal characteristics, such as antipyretic, depurative, diuretic, pectoral, and vermifuge antioxidant and anti-bacterial properties, and high nutritional value owing to its high vitamins content, minerals particularly P, Fe and fibers**.** Moreover, *Physalis peruviana* is vastly utilized in folk medicine for the treatment of malaria, asthma, hepatitis, dermatitis and rheumatism, reduction of bad cholesterol and glucose level. **(Licodiedoff *et al.,* 2013, Shabana, 2016).** Yogurt is a coagulated milk product produced from fermentation process by lactic acid bacteria (LAB).It is a healthy food due to its high digestibility and bioavailability. Fermentation process of LAB is a rich source of bioactive peptides with antioxidant activity, extend the shelf-life and maintain the nutritious components of milk (Gahruie *et al*., 2015 and Muniandy *et al*., 2016). Probiotic bacteria can tolerate acid & bile, survive in the intestinal tract and exert several beneficial effects on human health. They produce short-chain fatty acids and improve the intestinal microbial balance, resulting in the inhibition of bacterial pathogens, decreasing of colon cancer risk, promoting the immune system and lowering serum cholesterol levels (Gustaw *et al.,* 2011). Lactose intolerant people can consume yogurt without adverse effects (de Vrese *et al*., 2015). The addition of different fruits to milk may enhance the taste and the therapeutically values of milk products as well. Presenting a verity of fruit-flavored yoghurt has significantly participated to the consumption of yoghurt from all ages. Fruits may be added to yoghurt formulae as single or blends in the form of refrigerated, frozen, canned fruit, juice or syrup (Matter *et al.,* 2016).

Therefore, the objective of this study is to evaluate the quality properties of Husk Tomato as a natural juice. Then utilized this juice in addition to a probiotic strain to prepare stirred probiotic yogurt and assessed the antioxidant and sensory properties of the final product.

MATERIALS AND METHODS:

Materials:

Milk: Fresh full fat buffalo's milk was purchased from Faculty of Agriculture's farm, Cairo University, Giza. Egypt.

Lactic acid strains:

Lactobacillus delbrueckii subsp. *bulgaricus* Lb-12 DRI-VAC, provided by Northern Regional Research Laboratory. Illinois, USA; while *Streptococcus thermophilus* CH-1 and *Lactobacillus casei* FEGY 9973 (as probiotic strain) were obtained from Chr. Hansen's Lab., Denmark.

Husk Tomato fruits: Fine grade of Husk Tomato (***Physalis peruviana***, ***L.***) fruits were bought from hyper market from Giza, Egypt.

Microbial strains:

Different gram positive & negative bacteria, fungi and yeast such as *Bacillus cereus* B-3711, *Bacillus subtilus*, *Aspergillus flavus* 3357 and *Saccharomyces cerevisiae* Y-2223 were provided by the Northern Regional Research Laboratory Illinois, USA (NRRL). *Listeria monocytogenes* 598 was provided by the Department of Food Science, University of Massashusetts, Ambert MA, USA. *Escherichia coli* 0157: H7 and *Staphylococcus aureus* were isolated and serologically identified by dairy microbiological Lab., National Research Centre. *Yersinia enterocolitica* and *Salmonella typhamirum* were obtained from Hungarian National Collection of Medical Bacteria, OKI, Gyaliut 2-6, H-1966 Budapest, Hungary. *Aspergillus niger, Pseudomonas aeruginosa*, *Pencillium requfortii* J5 were obtained from Department of Microbiology, Swedish University of Agricultural Sciences. *Candidia albicans* were provided by the Institute of Applied Microbiology, University of Tokyo, Japan.

Methods of preparation and analysis:

Preparation of Husk Tomato Juice (HTJ): The outer cover had been removed from all fruits and well washed. After that, they put in a blender and well mixed till they were completely homogenized. The produced juice had filtered to separate seeds and skin by cheesecloth. The juice was heated to 85ºC/10 min then cooled to 4 ºC for utilizing in analyzing its components and preparing probiotic yogurt.

Assessment the antimicrobial activity of fresh Husk Tomato Juice:

0.1ml (10^9 cells /ml) of the tested strains was grown on trypton soya broth media at 37°C for 24h. For mold and yeast, the strains were grown in malt extract broth at 25°C for 72h, and then spread on the entire surface of the Petri dish using a sterile swab. The disc diffusion method as **(Randazzo *et al.,* 2016)** was used to determine the antimicrobial activity. The inhibition zones around the paper discs (mm) were measured. Another test of antimicrobial activity was assessment using pasteurized HTJ at 65ºC/15 min.

Preparation of Stirred Probiotic Yogurt (SPY):

Fresh buffalo milk with 7% sugar was pasteurized at 75º C/ 10sec ,cooled to 42ºC, 2% starter cultures (1:1%) and 1% *Lb. casei* FEGY9973 were added respectively. The fermented milk was rested till complete coagulation within 3 hours at 42 ºC (**Marshall and Rawson 1999)**. The curd was divided to five portions; the first was control (without juice), while the second, third, fourth and fifth treatments had been blended with HTJ at ratios of 20, 30, 40 and 50% (v/v) and served as T_1, T_2, T_3 and T_4. All samples were put in sterilized bottles near flame, and then stored in refrigerator at (5±2ºC) and analyzed when fresh and after 5, 10 and 15 days of cold storage.

Chemical Composition:

Total solids, total protein and ash contents of both HTJ and buffalo milk were determined according to **AOAC (2012).** Sugars in HTJ (Glucose, mannose and sucrose) and in buffalo milk (Lactose & Galactose) were estimated according to **Richmond *et al*., 1987** by using High Performance Liquid Chromatography (HPLC), Agilent 1200 series.

Determination of Husk Tomato juice components by High Performance Liquid Chromatography (HPLC):

HPLC analysis was carried out using Agilent Technologies 1100 series liquid chromatograph equipped with an auto sampler and a diode-array detector.The analytical column was Eclipse XDB-C18 (150 X 4.6 μm; 5 μm) with C18 guard column (Phenomenex, Torrance, CA). The mobile phase consisted of acetonitrile (solvent A) and 2% acetic acid in water (v/v) (solvent B). The flow rate was kept at 0.8 ml/min for a total run time of 70 min and the gradient programmer was as follows: 100% B to 85% B in 30 min, 85% B to 50% B in 20 min, 50% B to 0% B in 5 min and 0% B to 100% B in 5 min. The injection volume was 50 μl and peaks were monitored simultaneously at 280 and 320 nm for the benzoic acid and cinnamic acid derivatives, respectively. All samples were filtered through a 0.45 μm Acrodisc syringe filter (Gelman Laboratory, MI) before injection.

Determination of Minerals of Husk Tomato juice (HTJ):

Sodium (Na), potassium (K), magnesium (Mg), iron (Fe), calcium (Ca) and phosphorus (P) were determined with Optima 2000DV inductively coupled plasma spectrometer with full PC control (Perkin Elmer) according to **AOAC (2012).**

Total phenolic content and Radical Scavenging Capacity Assay (RSA):

Total phenolic compounds were determined according to **Zheng& Wang (2001)** using Folin-Ciocalteu reagent and expressed as milligrams of Gallic acid equivalents (GAE) / 100 gm. The Antioxidant activity of the extract was measured in terms of radical scavenging ability (RSA) using the stable free radical DPPH (2, 2-diphenyl-1picrylhydrazil) **(Pothitirat *et al.*, 2009).**

Sensorial evaluation:

Sensory attribution was carried out by 25 members in Dairy department, National Research Centre. Samples were evaluated in intervals at fresh, 5, 10 and 15 days of storage period. The evaluation degrees were included flavor (50), appearance (10), body and texture (40).

Statistical Analysis:

Statistical analysis of obtained data was carried out using analysis of variance (ANOVA) and Duncan tests with the Statistical Analysis System **(SAS, 2004).** A probability of $P < 0.05$ was used to establish the statistical significance.

RESULTS AND DISCUSSION

Chemical composition and Sugar contents of Husk Tomato Juice (HTJ) and buffalo milk samples:

Table (1) showed some chemical composition and sugars contents of HTJ and buffalo milk. Husk Tomato Juice had 20.23, 0.98, 0.43 and 2.38 % for total solids, total protein, fat and ash contents respectively. Also, same Table exhibited that Sucrose, Glucose and Mannose contents of the juice were 3.55, 1.14 and 1.06 mg/100ml, respectively. Our results were varied with that found by **El-Sheikha *et al.,* 2010** who pointed that raw juice contained glucose (2.28 g/L), fructose (2.31 g/L) and sucrose (2.81 g/L) which were lower than in lime juice (6 g/L glucose, 6.1 g/L fructose and 4.8 g/L sucrose).**El- Sheikha *et al.,* 2008**, **2010** stated that the chemical composition of *physalis* juice were 89.34, 1.02 and 5.58% for moisture, protein and ash, respectively. On the other side, **Sharoba and Ramadan (2011)** declared that golden berry fruit contained 21.00, 16.40, 1.08, 0.84 and 0.32% for dry matter, water soluble dry matter, ash, protein and oil respectively. Also**, Yıldız *et al.*, 2015** illustrated that the composition of *Physalis peruviana L.* were 18.67, 14.17, 2.98, 1.66, 0.18 and 13.86 %, for dry matter, water soluble dry matter, ash, protein, oil and carbohydrate respectively. While the contents of buffalo milk were 16.39, 3.97, 6.21 and 0.80 % for total solids, total protein, fat and ash respectively. Lactose and galactose contents of buffalo milk were 30.65 and 0.751 mg/L. Data of buffalo milk chemical composition and sugar contents was in accordance with **Abbas *et al.*, 2017.** They cleared that the chemical composition of buffalo milk was 16.50, 3.64, 6.30, and 0.78 % for TS, TP, fat and ash contents respectively.

Table (1): Chemical composition and sugar contents of Husk Tomato Juice and buffalo milk.

Items	Husk Tomato Juice	buffalo milk
Total Solids (TS) %	20.23	16.39
Total Protein (TP) %	0.98	3.98
Fat %	0.43	6.21
Ash %	2.38	0.80
Lactose mg/L	-	30.65
Galactose mg/L	-	0.751
Sucrose g/100ml	3.55	-
Glucose g/100ml	1.14	-
Mannose g/100ml	1.06	-

Some components of fresh Husk tomato juice by HPLC analysis:

Fresh HTJ were analyzed for its constituents using HPLC. Different components were found at various ratios (Table2). As it expected most of them considered as phenolic and antioxidant components. Main compounds were Sinapic (8.170µg/ml), Protocatechuic (6.344µg/ml), Cinnamic (4.66µg/ml) and Ferulic (3.090µg/ml), Caffeic (0.153**µg/ml**), Quercetin

(0.077**µg/ml**) which considered as flavonols. Same line had been shown by **El-Sheikha *et al.*, 2008** who clarified the major phenolic compounds of fresh apricot juice. They were ferulic, salicylic and chlorogenic acids, where the predominant compound was resorcinol. Also, in **2009 and 2010 El-Sheikha *et al.*,** were recognized about 12 phenolic fractions in the methanolic extract of fresh *Physalis* juice. The predominant compounds were phenols followed by ferulic acid. They declared that slight decrease in polyphenol compounds was inversely proportional to the non-enzymatic browning reactions which increased slowly throughout the cold storage time. While, **Deng *et al.*, 2016** isolated some antioxidant fractions like Syringic acid 6-*O*-β-glucuronopyranoside, Quercetin-3-*O*-β-D-glucopyranoside and Caffeic acid.

This

Table (2): Some main components of fresh Husk Tomato Juice (HTJ) by HPLC.

Compounds	Retention time	Concentrations (µg/ml)
Sinapic	33.0	8.170
Protocatechuic	9.6	6.344
Cinnamic	42.4	4.660
Ferulic	31.6	3.090
P–hydroxybenzoic	14.7	1.341
Rosmarinic	39.5	1.052
Chrysin	51.3	0.856
Apigenin-7-glucoside	38.5	0.128
Caffeic	20.8	0.153
Quercetin	43.1	0.077
Syringic	22.3	0.069
Vanillic	23.9	0.063
Chlorogenic	20.0	0.020
Rutin	35.8	0.080
P-coumaric	36.3	0.060

Minerals compounds and antioxidant activity:

Some mineral contents in fresh HTJ appeared in Table (3). The content of calcium (62.14 mg/100ml), iron (1.766 mg/100ml), potassium (893 mg/ml), magnesium (11.27 mg/ml), sodium (17.436 mg/100ml) and traces of selenium (1.03ppm), respectively. These data were close to results which found by **El-Sheikha *et al.*, (2008).** They conducted that potassium, phosphorus, calcium, sodium, magnesium, zinc, copper, iron and manganese were 1196, 587, 70, 35, 19, 2.4, 1.5, 1.2 and 0.6 mg/100ml juice, respectively. **Ramadan and Moersel in 2011 and Sharma *et al.*, 2015** displayed that *Physalis peruviana* pulp contained essential minerals such as iron, calcium, phosphorus and zinc. Theses minerals have potential health effect on human. The same table reflected also the total phenol contents which were 319.15 GAE/100gm and the percent of DPPH was 68.88 %. Our results were higher that the results by **Yıldız *et al.*, 2015** who demonstrated the antioxidant capacity and total phenolic content in *Physalis peruviana L.* fruit were 57.67 % and 145.22 mg GAE/100 g, respectively.

Table (3): Some minerals, antioxidant activity and total phenolic contents of fresh Husk Tomato Juice.

Minerals **Content (mg/100ml juice)**	
Calcium	62.14
Iron	1.766
Potassium	893
Magnesium	11.27
Sodium	17.436
Selenium(ppm)	1.03
Antioxidant activity	
DPPH (%)	68.88
Total Phenolic Content	
Total phenolic content as Gallic acid equivalent (GAE)/100gm	319.15

Valdenegro *et al.*, (2013) and Yıldız *et al.,* 2015 assayed the antioxidant capacity and total phenolic content in golden berry fruit and they ranged from 57.67 % & 5.84 mmol DPPH/100g and 145.22 mg & 2.46 g GAE/100 g, respectively. As well **Ramadan and Moersel (2008)** illustrated that phenolic compounds are very important for their contribution to the sensory quality of fruits (color, astringency, bitterness and flavor) and technological processes.

Assessment of the antimicrobial activity of Husk Tomato juice:

The Husk Tomato Juice was screened for its antimicrobial activity against eight bacterial and five fungal strains Table (4). The results indicated that HTJ had various degrees of inhibition against the growth of some pathogenic and fungi. The highest antimicrobial activity of HTJ was found against *Y. enterocolitica* and *Ent. faecalies*. While, the lowest activity was recorded against *A. niger* and *List. monoytogenes*. The diameter zone of inhibition ranged from 18 to 25, 6 to 25 and 7 to 17 mm for gram positive & negative bacteria and fungi, respectively. The antimicrobial activity of HTJ could be due to the phenolic compounds which had been found in the juice as mention before by HPLC analysis.

Also, the results mentioned that the activity of HTJ was not affected by pasteurization, it was obvious that pasteurized HTJ were more effective against *Y. enterocolitica*, which had diameter 22 mm of inhibition zone. Otherwise, *A. niger* and *List. Monoytogenes* had less inhibition zone reached to 6 and 7 mm, respectively. The diameter zone of inhibition ranged from 16 to 20 mm and 7 to 22 mm for both of gram positive and negative bacteria respectively, while the diameter zone of fungi recorded 6 to 17 mm. Our results in the same trend with **EL Sheikha *et al.*, (2008)** who showed that metabolic extract of juice had significant antimicrobial activity against *E. coli* O15:H7 and *B. subtilus*. In addition **Nathiya and Dorcus (2012)** confirmed our results by testing the antibacterial effect of *Physalis minima* Linn fruit. They pointed that the antibacterial impact against *Bacillus cerues*, *Enterobacteraero genes* and *Staphylococus aureus* was greater with maximum inhibition zone (10.0 mm ± 0.5). *Staphylococcus aureus* was established to be more susceptible with a maximum inhibitory zone of 9.0mm ± 1.0

Table (4): Antimicrobial effect of Husk Tomato juice against pathogenic strains.

Pathogenic strains	Husk Tomato juice	pasteurized Husk Tomato juice
	(Diameter of inhibition zone (mm	
Bacillus cereus(G+)	19	15
Bacillus subtilus(G+)	18	16
Staphylococcus aureus(G+)	17	15
Pseudomonas aeruginosa (G-)	18	16
Listeria monoytogenes(G+)	6	7
Escherichia coli(G-)	12	10
Yersinia enterocolitica(G-)	25	22
Salmonella typhmirum(G-)	22	19
Enterococcus faecalies(G+)	25	20
Aspergillus niger	7	6
Aspergillus flavus	12	11
Pencillium requfortii	18	17
Saccharomyces cerevisiae	17	15

(G+): Gram positive bacteria, (G-): Gram negative bacteria

Yogurt properties:

Antioxidant Activity of stirred probiotic yoghurt during storage:

Table (5) illustrated antioxidant activity of stirred probiotic yoghurt when fresh and after 5, 10 and 15 days. It was observed that treatment samples which contained HTJ had higher antioxidant activity than control samples in all storage periods. Antioxidant activity was in directly proportional to the ratio of the juice in all treatments. So, treatment (T_4) had significantly ($p<0.05$) the highest antioxidant activity (70.59%) compared to other samples and control. This activity could be due to the phenolic compounds which existed in Husk Tomato Juice. The decrease in antioxidant activity in control samples was higher than treatment samples either fresh or stored. So, the antioxidant activity could be affected by the mechanical process and the loss of vitamin C due to auto-oxidation. **Lourens-Hattingh and Viljoen, 2001; Correia *et al*., 2004** displayed fermentation and post-acidification products produced during storage such as organic acid derivative and milk protein proteolysis could be possible sources of DPPH inhibitors**.** Same line was found by **Shori and Baba, (2013)** when added *Azadirachtaindica* which had high ratios of vitamin C and riboflavin to yogurt showed higher antioxidant effect compared to plain yogurt after 28 days of storage. Presented results were in accordance with **Nguyen and Hwang (2016)**.

Table (5): Antioxidant activity (%) of stirred probiotic yoghurt when fresh and during storage.

Storage period (Days)	Treatment samples				
	Control	T_1	T_2	T_3	T_4
Fresh	66.57^{Ca}	67.66^{Ba}	67.93^{Ba}	69.34^{Aa}	69.59^{Aa}
5	66.48^{Ca}	66.61^{Cab}	67.63^{Ba}	68.78^{ABb}	69.9^{Aa}
10	65.39^{Cb}	66.7^{Bab}	66.79^{Bb}	68.2^{Abc}	68.79^{Ab}
15	64.96^{Dc}	65.43^{Cb}	66.56^{BCb}	67.9^{Bc}	68.34^{Ab}

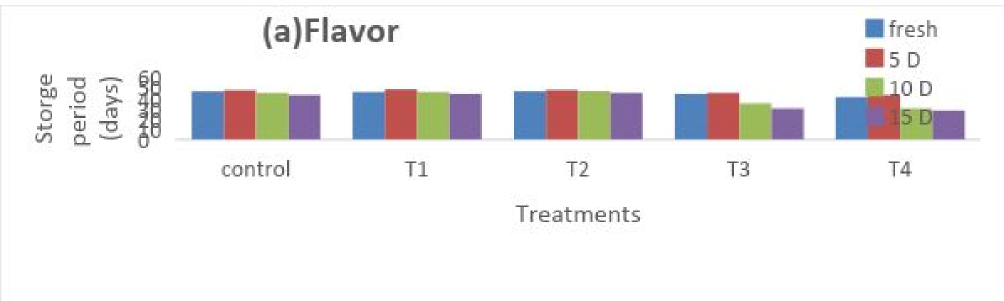
T_1= 20% HTJ T_2= 30% HTJ T_3= 40% HTJ T_4=50% HTJ

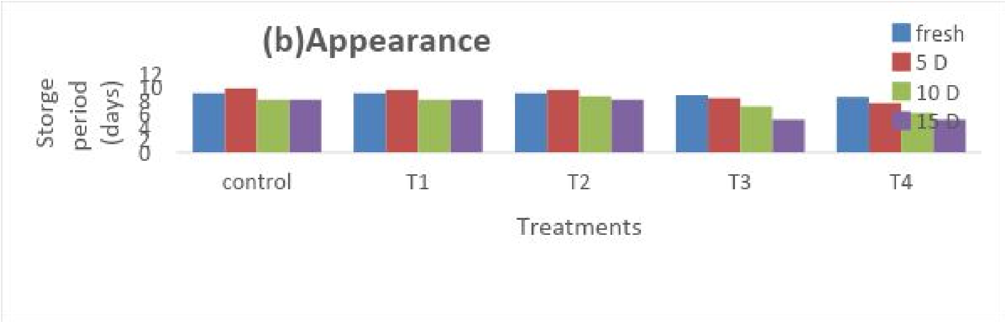
Data expressed as mean of 3 replicates. Means in the same row showing the same capital letters are not significantly different ($p \leq 0.05$). Means in the same column showing the same small letters are not significantly different ($p \leq 0.05$)

Sensorial evaluation:

Data in Fig. (1), represented sensorial evaluation of stirred probiotic yoghurt fortified with different ratios of Husk Tomato juice. No doubt that HTJ gave the new stirred yoghurt a special taste that all panelists favorite it. The most two favorable flavor were T_1 and T_2 treatments which contained 20 and 30% HTJ compared with other treatments. Flavor scores gradually increased among the first week for all treatments then decreased till the end of the experiment. During storage period, the higher ratios of HTJ (40 and 50%) had lower scores for flavor when fresh and after 15 days. This could be due to the high acidity of this juice combined with starter culture. On the other hand, appearance for all samples was insignificant ($p>0.05$) except after 15 days of storage period for T_3 and T_4; there were low scores of appearance. Body & texture for control, T_1 and T_2 samples had high scores against the other treatments. Control samples had significantly ($p< 0.05$) gained higher scores for body & texture than treated samples because the juice diluted the stirred probiotic yoghurt according to the ratio of the juice.

In comparison with present study; **Abou Ayana *et al.,* (2012)** noticed the changes in sensory evaluation of fruity probiotic fermented milk. They showed that the total scores gradually increased in all examined treatments in the first week, and then decreased till the end of storage. Also, they observed negative impact emerged with adding fruit pulp on body and texture; this may be due to the weakness of the casein network.





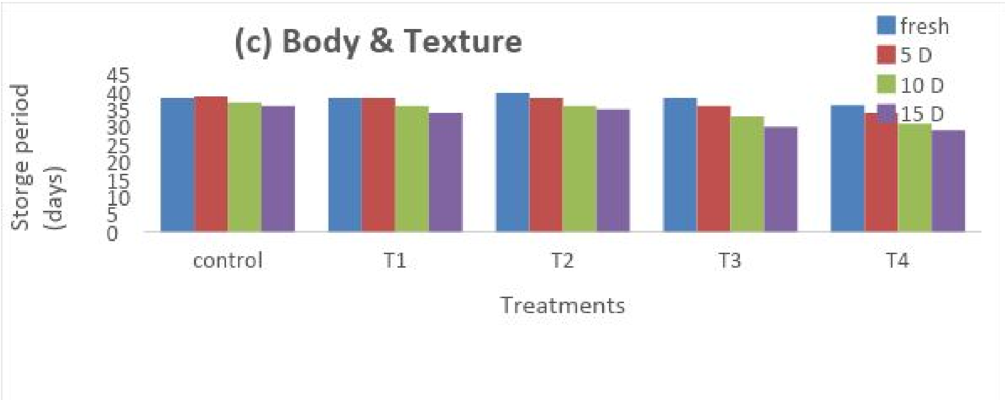


Fig (1): Sensory evaluation of stirred probiotic yogurt during storage.
(a) Flavor (b) Appearance (c) Body & texture.

T_1= 20% HTJ T_2= 30% HTJ T_3= 40% HTJ T_4=50% HTJ

Conclusion:

Producing a novel healthy dairy product has got consumer admire is the principle aim of this study. Fortifications with two ratios of Husk Tomato Juice (20 and 30%) in stirred probiotic yoghurt were more favorable to panelists. Also, addition of this juice enhanced the antioxidant and sensory properties of the dairy product.

Future Trends:

Husk Tomato should magnetize great interest because of their nutritional and industrial characteristics. Because of its unique storage properties, wherein the fruits can be kept for a long time, Husk Tomato could be an appropriate plant for various food applications. The development of sufficient agro-technical methods can make this fruit a promising profitable new crop for arid regions. Consequently, further studies must be taken in consideration for applied this fruit in food and dairy processing. Therefore, a novel healthy product can be spreadable in the local markets. So, this paper has second part including some important parameters for the juice and the end product as well.

REFERENCES:

Abbas H M, Ali A O, Kassem J M and Zaky W M. Evaluation of different types of Egyptian milk from biochemical aspects. Int. J. Dairy Sci., **(2017)**; 12(2):130-136.

Abou Ayana I A, Gamal El Deen A A and Ayaad K M K. Influence of Some Additives on The Properties of Flavored With Fruit Probiotic Fermented Milk. Journal of Food and Dairy Science, Mansoura Univ., **(2012)**; 3 (12): 623 – 635.

AOAC (2012). Association of Official Analytical Chemists 2012. Official Methods of Analysis. 19th Ed., Gaithersburg, M D, USA.

Correia I, Nunes A, Duarte IF, Barros A and elgadillo I. Sorghum fermentation followed by spectroscopic techniques. Food Chemistry, **(2004)**; 90(4): 853–859.

Deng K, Zang L, Lan X, Zhong Z, Xiong B, Zhang Y and Zheng X. Antioxidant Components from CapeGooseberry. Journal of Food Processing and Preservation, **(2016)**; 40: 893-898.doi.org/10.1111/jfpp.12667.

de Vrese M, Laue C, Offick, B, Soeth E, Repenning F, Tho A and Schrezenmeir J. A combination of acid lactase from Aspergillus oryzae and yogurt bacteria improves lactose digestion in lactose maldigesters synergistically: a randomized, controlled, double-blind cross-over trial. Clin Nutr., **(2015);** 34: 394-399.

El Sheikha AF. (2004). Technological, Chemical and Microbiological Studies on Some Packed Foods. MSc Thesis, Faculty of Agriculture, Minufiya University, Egypt, pp. 174.

El Sheikha AF, Zaki MS, Bakr AA, El Habashy MM and Montet D. Physicochemical properties and biochemical composition of Physalis (*Physalispubescens*L.) fruits, Food, **(2008);** 2 (2):124–130.

El-Sheikha AF, Ribeyre F, Larroque M, Reynes M and D Montet. Quality Of Physalis (Physalis Pubescens L.) Juice Packaged in Glass Bottles and Flexible Laminated Packs During Storage at 5°C. African J. Food Agriculture Nutrition and Development, **(2009)**; vol.9; no.6: 1388-1405.

El Sheikha A F, Piombo G, Goli T and Montet D. Main composition of Physalis (*Physalispubescens*L.) fruit juice from Egypt. Fruits, **(2010);** vol. 65, p. 255–265.DOI: 10.1051/fruits/2010021.

Gahruie H H, Eskandari M H, Mesbahi G and Hanifpour M A. Scientific and technical aspects of yogurt fortification: a review. Food Sci Hum Wellness**, (2015)**; 4: 1-8.

Gustaw W, Kordowska-Wiater M and Kozioł J. The Influence of Selected Probiotics on The Growth Of Lactic Acid Bacteria For Bio-Yoghurt Production. Acta Sci. Pol., Technol. Aliment. **(2011)**; 10(4): 455-466.

Hemalatha R, Amarjeet Kumar Om Prakash A Supriya, A S Chauhan and Kudachikar V B Development and Quality Evaluation of Ready to Serve (RTS) Beverage from Cape Gooseberry (Physalis peruviana L.) Beverages, **2018**; 4, 42.

Jalal H, Para P A, Ganguly S, Devi S, Bhat M M, Bukhari S A and Qadri K. Fortification of Dairy Products: A Review. World Journal of Biology and Medical Sciences, **(2016**); 3 (1): 23-35.

Licodiedoff S, Koslowski L A D and Ribani R H. Flavonols and antioxidant activity of *Physalis peruviana* L. fruit at two maturity stages. Acta Scientiarum. Technology Maringá, **(2013)**; v. 35, n. 2, p. 393-399, Apr.-June.

Lourens-Hattingh A and Viljoen BC. Yogurt as probiotic carrier food. International of Dairy Journal, **(2001)**; 11 (1-2): 1–17.doi.org/10.1016/S0958-6946(01)00036-X**.**

Marsh A J, Hill C, Ross R P and Cotter P D. Fermented beverages with health-promoting potential: past and future perspectives. Trends in Food Science and Technology, **(2014)**; 38 (2): 113-124.doi:10.1016/j.tifs.2014.05.002.

Marshall VM and Rawson HL. Effect of exoploysaccharide–producing strains of hermophilic lactic acid bacteria on the texture of stirred yoghurt. International Journal of Food Science and Technology, **(1999)**; 34 (2): 137-143.doi.org/10.1046/j.1365-2621.1999.00245.x.

Matter A A, Mahmoud E A M and Zidan N S. Fruit Flavored Yoghurt: Chemical, Functional and Rheological Properties**.** International Journal of Environmental & Agriculture Research (IJOEAR), **(2016)**; ISSN:2454-1850 Vol-2, Issue-5:57-66.

Muniandy P, Shori A B and Baba A S. Influence of green, white and black tea addition on the antioxidant activity of probiotic yogurt during refrigerated storage. Food Packag Shelf Life, **(2016)**; 8: 1-8.

Mustafa A M M (2009). Effect of nitrogen, potassium fertilization and their interactions on yield and quality of husk tomato. MSc. Thesis, Fac. Agric. Alexandria University.

Nathiya M and Dorcus D. Preliminary phytochemical and anti-bacterial studies on *Physalisminima* Linn. International Journal of Current Science, **(2012);** 32: 24-30.

Nguyen L and Hwang E. Quality Characteristics and Antioxidant Activity of Yogurt Supplemented with Aronia (Aroniamelanocarpa) Juice. Preventative Nutrition and Food Science, 21 4): **(2016)**; 330-337.doi: 10.3746 /pnf .2016. 21.4.330.

Pothitirat W, Chomnawang MT, Supabphol R and Gritsanapan W. Comparison of bioactive compounds content, free radical scavenging and anti-acne inducing bacteria activities of extracts from the mangosteen fruit rind at two stages of maturity. Fitoterapia, **(2009)**; 80: 442–447.doi: 10.1016/j.fitote.2009.06.005.

Ramadan M F and Moersel J T. Impact of enzymatic treatment on chemical composition, physicochemical properties and radical scavenging activity of goldenberry (*Physalisperuviana* L.) juice. Journal of the Science of Food and Agriculture, **(2008)**; 87: 452-460.doi.org/10.1002/jsfa.2728.

Ramadan MF and Mörsel JT. Physalis peruviana: A rich source of bioactive phytochemicals for functional foods and pharmaceuticals. Food Rev. Int., **(2011)**; 27, 259–273.

Randazzo W, Jiménez-Belenguer A, Settanni L, Perdones A, Moschetti M, Palazzolo E, Guarrasi V, Vargas M. Anti-listerial effect of citrus essential oils and their performance in edible film formulations. Food Control, **(2016)**; 59: 750-758.doi:10.1016/j.foodcont.2015.06.057.

Richmond M L, Harte B R, Gray J I and Stine C M. Determination of sugars in yogurt and microbiological media by high performance liquid chromatography during processing and subsequent storage. J. Dairy Sci., **(1987);** 70:1140-1147.

SAS (2004). SAS User's Guide: Statistics, Version 6.04. 4th Ed., SAS Inst. Inc., Cary, NC., USA.

Shabana A I. Organic Husk Tomato (physalis peruviana, L. Production for Exportation. J. Plant Production, Mansoura Univ., **(2016)**; vol. 7(8):843-850.

Sharma N, Bano A, Dhaliwal H S and Sharma V. Perspectives and possibilities of Indian Species of *Physalis*(L.)– A Comprehensive Review. European Journal of Pharmaceutical and Medical Research, **(2015);** 2 (2): 326-353.

Shori AB and Baba AS. Antioxidant activity and inhibition of key enzymes linked to type-2 diabetes and hypertension by Azadirachtaindica-yogurt. Journal of Saudi Chemical Society, **(2013);** 17: 295–301.doi:10.1016/j.jscs.2011.04.006.

Valdenegro M L, Almonacid S, Henríquez C, Lutz M, Fuentes L and Simpson R. The effects of drying processes on organoleptic characteristics and the health quality of food ingredients obtained from goldenberry fruits (Physalisperuviana). Open Access Scientific Reports, **(2013);** 2:642-648.doi:10.4172/ scientific reports .6 42.

Yıldız G, İzli N, Ünal H and Uylaşer V. Physical and chemical characteristics of goldenberry fruit (*Physalisperuviana* L.).J Food Science and Technology, **(2015)**; 52(4):2320–2327. DOI 10.1007/s13197-014-1280-3.

Zheng W and Wang SY. Antioxidant activity and phenolic compounds in selected herbs, Journal of Agricultural and Food chemistry, **(2001)**; 49: 5165-5170.**DOI:** 10.1021/jf010697n.