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Physicochemical Properties And Potential Probiotic Effect Of Whey Protein On Fruits Jelly.

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ABSTRACT

Whey protein (WP) is considered as a nutritional and functional ingredient, which is containing biologically active proteins. In this study WP was added to fruits jelly with two ratios 5% and 10% in order to enhance the protein content. Also, the physiochemical properties and probiotic effects of them were evaluated. Fruits jelly have been prepared by added pomegranate and guava lyophilized fruits, T1 pomegranate jelly, T2 pomegranate jelly with 5% WP, T3 pomegranate jelly with 10% WP, T4 guava jelly, T5 guava jelly with 5% WP and T6 guava jelly with 10% WP. The results recorded that, the highest moisture content was recorded in T1 and T4 85.01±0.08 %, 85.01±0.08%, respectively. Also, there were slight differences in the total soluble solid (TSS) content of the formulas, it ranged from 13.20 to 14.80 (°Brix). The highest percent of total protein content were observed in T3 and T6 with 0.21±0.00% ,0.22±0.02%, respectively. The probiotic effect was conducted to test the effect of the product on beneficial bacteria which presented in the digestive system. Our results showed that fruits jelly have the positive effect on the growth rate of five strains of Lactobacillus. As well, the percent of growth rate was increased when increased the percent in WP. The sensory and physicochemical analysis results showed that jelly was acceptable and had good physicochemical attributes. Our findings indicated that jelly have an excellent potential for commercialization.

Keywords: whey protein, fruits, jelly, protein, pomegranate, guava, probiotic, lyophilized.

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INTRODUCTION

Whey milk represents approximately (18-20)% of the original milk proteins. It exhibits many important functional properties in the manufacture of food [1]. Approximately 47 % of the 115 million tons of whey produced world–wide every year are disposed into rivers, lakes, or other water bodies, into wastewater treatment plants or loaded onto the land [2]. WP is an admixture of globular proteins isolated from whey, a by-product of cheese production. It has lactose free and fat free. Whey considers complete protein which contains essential and non-essential amino acids [3]. WP ingredients are used to replace other proteins or to improve the functional properties of many food products. They are comprised mainly of β-lactoglobulin (β-Lg),αlactalbumin (α-La), bovine serum albumin (BSA), and immunoglobulin, and the effects of WP functionality have been studied extensively [4].

It has been broadly used in food industry due to its high nutritional value and unique functional properties [5]. The expanded use of whey protein in the food industry is due to its excellent thermal stability, gelation, foaming and emulsification properties. WP is well known as replacements for egg proteins in confectionery and bakery products. Also, it used as functional ingredients and milk replacers in dairy products such as ice cream [6]. Confectionery coatings prepared by using whey in the formulations have promoted the flavor, color, and texture characteristics of the final product [7].

Of all the conventional food preserves, jelly has been widely served in restaurants, allowing the off-season consumption of fruits. Jelly production is a good example of a product easy to produce, with long storage periods that continue to have the value of fruit [8]. Jelly is viscous or semi-solid foods made from a mixture of not less than 45 parts by weight of saccharine ingredient. To yield perfect jelly, fruits required for jelly making should contain sufficient acid and pectin [9]. Thus, the aim of this study was to evaluate physiochemical properties and probiotic effect of adding WP by two ratios (5%-10%) on pomegranate and guava jelly.

MATERIALS AND METHODS

Materials

The experimental materials were collected from the local market in Jeddah – KSA, gelatin (Abed edible gelatin powder 100% beef origin), citric acid, sugar and whey protein isolate (Gold Nutrition). All chemicals were purchased from Al-Rowad modern Est. Jeddah, KSA. Pomegranate and guava fruits were collected from local market in Taif – KSA during the season.

Methods

Lyophilized (freeze-drying) fruits: Lyophilized of pomegranate and guava fruits was according to the method of [10, 11].

Preparation of fruits jelly: The control sample was contained all ingredients showed in table. 1 except WP samples. Whey protein added to the jelly by two ratios 5% and 10% as supplement for jelly.

Table 1: Formulations of fruits jelly with diffreeant concentaration of WP

Ingredients	Formulations					
	Pomegranate jelly			Guava jelly		
	T1	T2	T3	T4	T5	T6
WP(g)	0	15	30	0	15	30
water(ml)	300	285	270	300	285	270
sugar(g)	25			25		
freeze-dried fruits(g)	25			25		
Gelatin(g)	9			9		
Citric acid(g)	0.50			0.50		

Analytical properties: protein content, total soluble solids (TSS), titratable acidity, moisture content, total ash and PH. were determined according to the method described by [12].

Sensory analysis of fruits jelly: Sensory quality characteristics were evaluated by a panel of 20 members, untrained volunteer consumers from the university. through a 9-point hedonic scale. Jelly was evaluated for their overall acceptability, taste, color, flavor, texture, and transparency [13].

Probiotic effect: Safety of using jelly extract in the growth of some probiotic bacteria in the microbial balance in digestive system. Growth for *lactobacillus plantarum, Lactobacillus acidophilus, lactobacillus gasseri, lactobacillus reuteri and lactobacillus helveticus* was measurement after activation for 24 hrs. 5 g of product was added at MRS (De man, Rogosa and Sharpe) agar to 1ml of each selected activated probiotic bacterium comparing to control sample for each bacterium in a media without product. Samples were incubated anaerobically at 30°C for 48 hrs. Determined colorimetry using spectrophotometer (Jenway 7305 UV/Vis) at 620 nm after 48 hrs for each selected probiotic bacterium. It was determined according to the method described by [14].

Statistical analysis: All data obtained results were analyzed using (SPSS) for windows, version 23. Three replications of the study performed, and measurements of physiochemical parameters. Collected data were presented as mean± standard deviation (SD). One-way analysis of variance (ANOVA) followed by Tukey's HSD test was used for determining the significances among different groups were considered significant provided that P-values were <0.05.

RESULTS AND DISSECTION

Physicochemical properties

Pomegranate and guava jelly were analyzed for some physical and chemical properties. The results are tabulated in table 2 and 3.

Table 2: Some physio-chemical analysis of pomegranate jelly

Components	T1	T2	T3
Protein (%)	$0.06±0.02^a$	$0.14±0.03^b$	$0.21±0.00^c$
Moisture (%)	$84.99±0.07^c$	$82.62±0.49^b$	$81.66±0.08^a$
Ash (%)	$0.19±0.00^a$	$0.37±0.02^b$	$0.43±0.04^b$
Total soluble solids (˚Brix)	13.20±0.00	13.90±0.00	14.50±0.00
Total acidity (as % citric acid)	$0.47±0.01^c$	$0.43±0.00^b$	$0.40±0.00^a$
pH-value	$3.24±0.03^a$	$3.74±0.02^b$	$4.10±0.03^c$

N=3 (Mean±SD), Different litters in the same raw implies significant difference at P ≤ 0.05

Table 3: Some physio-chemical analysis of guava jelly

Components	T4	T5	T6
Protein (%)	$0.08±0.05^a$	$0.15±0.02^b$	$0.22±0.01^c$
Moisture (%)	$85.01±0.08^c$	$83.59±0.11^b$	$81.92±0.17^c$
Ash (%)	$0.28±0.00^a$	$0.36±0.04^b$	$0.45±0.03^b$
Total soluble solids (˚Brix)	13.40±0.00	13.90±0.00	14.80±0.00
Total acidity (as % citric acid)	$0.31±0.00^c$	$0.30±0.10^b$	$0.28±0.00^a$
pH-value	$3.55±0.01^a$	$3.64±0.00^b$	$4.42±0.02^c$

N=3 (Mean±SD), Different litters in the same raw implies significant difference at P ≤ 0.05

The protein content of most fruits jelly is very low due to the low protein content of most of the fruit pulp and none of the ingredients used in jelly preparation are an abundant source of protein [15]. As expected, protein contents of fruits jelly containing WP were higher than other products. Our data showed that, when fruits jelly mix with different levels (5% and 10%) of WP, it was found that T3 had a high protein contents in pomegranate jelly and T6 in guava jelly. The protein contents of jelly were found to be different than those reported by Pandiyan, Villi [16]. The variation may be due to the protein level used for the treatments.

Also, the highest content of moisture was recorded 85.01±0.08 % and 85.01±0.08 in T1 of guava jelly and % T4 of pomegranate jelly, respectively. The highest moisture content for fruits jelly resulted from the low soluble solids content which these treatments have low amounts of sugars. Similar results were recorded by Relekar [17] in pomegranate sapota blended jelly.

Furthermore, the ash content was ranged between (0.19±0.00 - 0.43±0.04) % of pomegranate jelly and (0.28±0.00 -0.45±0.03) % of guava jelly. These results were agreed by Wasnik [18], who found that, five different proportions of paneer whey jelly between (0.09 ± 0.01– 0.42 ± 0.01) % of ash content. The increase in total ash from treatment T1 to T6 may be due to increasing mineral content contributed by rising levels of whey.

Also, there were slight differences in the total soluble solid (TSS) of the formulas. It ranged from 13.20 to 14.50 ∘Brix and 13.40 to 14.80 ∘Brix in pomegranate and guava jelly , respectively. These results were close to Rubio-Arraez, Benavent [19],who found that, watermelon jelly reached a concentration of soluble solids between (14-16) ∘Brix.

On the other hand, total acidity in guava jelly formulas recorded the same percentage compared with Khaton (2011).While, our results in pomegranate jelly were lower than the range reported by Thakur and Dhaygude (2017) [20]. They found that, total acidity in pomegranate jelly ranged from 0.75% to 0.71%. The difference in ratio may be due to difference in the fruit species and their content from sugars.

As regarding the pH-values it was range between 3.24±0.03 to 4.10±0.03 in pomegranate jelly and 3.55±0.03 to 4.42±0.03 in guava jelly. It was increased with adding WP, this may be due to lower in acidity. Similar values were recorded by Ventura, Alarcón-Aguilar [21] for pomegranate jelly and Moura, Prati [22] for guava jelly.

Sensory analysis of fruits jelly

Data in table. 4 and 5 showed the mean sensory score of fruits jelly for different samples. The samples were sensory evaluated for overall acceptability, taste, color, flavor, texture, and transparency. It could be clear that nearly all samples products were almost palatable among different panelists. The color of pomegranate jelly (T1) had the best score. However, a statistically significant difference was observed in color and transparency among pomegranate jelly. Also, the results of mean sensory score of guava jelly were observed that guava jelly sample (T4) was liked most by sensory panel members as compared to the other combinations. T3 and T6 with adding 10% of WP were slightly hard in texture compared with other samples such as the results of panelists showed. Transparency of jellies was decreased after the addition of WP. Moreover, differences were found between our results from the sensory evaluation those obtained in the study of Wasnik [18], because the developed jellies was with whole paneer whey not with WP.

Table 4: Mean sensory score of pomegranate jelly for different samples

Samples	Color	Taste	Flavor	Texture	Transparency	Overall acceptability
T1	$8.30{\pm}1.12^{b}$	5.20±2.11	4.70±2.15	7.90±1.58	$7.05{\pm}2.16^{b}$	6.20±1.93
T2	$6.95{\pm}2.11^{ab}$	5.00±2.17	4.45±2.25	7.80±1.79	$5.65{\pm}2.27^{ab}$	5.65±2.13
T3	$6.40{\pm}2.25^{a}$	4.90±2.04	4.75±2.07	7.10±1.99	$5.00{\pm}2.36^{a}$	5.45±2.16

N=20 (Mean±SD), Different litters in the same in a column implies significant difference at P ≤ 0.05

Table 5: Mean sensory score of guava jelly for different samples

Samples	Color	Taste	Flavor	Texture	Transparency	Overall acceptability
T4	7.10±2.33	7.30±2.12[a]	7.60±1.95[b]	7.50±1.85	5.25±2.48	7.25±1.99
T5	6.25±2.19	5.75±2.03[a]	5.45±2.56[a]	7.00±2.05	4.55±2.08	6.10±1.65
T6	6.50±1.98	5.85±2.20[a]	5.90±2.57[ab]	6.80±2.23	4.35±1.92	6.10±2.15

N=20 (Mean±SD), Different litters in the same in a column implies significant difference at P ≤ 0.05

Probiotic effect

The probiotic effect was conducted to experiment the effect of the product on beneficial bacteria found in the digestive system. Our results in fig.1 and 2 showed that fruits jelly have positive effect on the growth rate of five strains *Lactobacillus*. Also, the percent of growth rate was increased when increased the percent in WP. This is may be due to the presence of lactoferrin in a fruits jelly with WP. *Lactobacilli* can use lactoferrin-bound iron, thus allowing lactoferrin to support the growth of *lactobacilli* [23]. Moreover, Rajam, Karthik [24], studied effect of WP wall systems on survival of microencapsulated *Lactobacillus plantarum* in simulated gastrointestinal conditions. Microencapsulation of *Lactobacillus plantarum* with wall material combinations of whey protein isolate and sodium alginate to investigate the effectiveness of the encapsulating wall materials on cell survival during processing and cell release in simulated acidic and bile conditions. They proved that, WP wall matrix was able to deliver probiotics with an improved survival rate.

On the other hand, the prebiotic fibers in fruits were encouraged the positive effect on the growth rate of probiotics. Due to that the use of prebiotics one of the recommended ways to maintain high viable numbers of probiotic bacteria in the intestine [25]. Also, dietary fibers can preserve probiotic cells during processing, via a mechanism that involves the physical immobilization of the cells on to the fiber [26]. As well, the highest percent of cell survival was 73.61% (T6) in *lactobacillus plantarum*, which had the highest pH (pH ~ 4.4). Nualkaekul and Charalampopoulos [27] reported that, high pH enhanced cell survival in fruit juices. Very good cell survival was observed in orange, blackcurrant and pineapple juice, all of which had a high pH of about 3.8. Whereas in the case of lemon juice, cell survival decreased because the lemon juice had the lowest pH (pH~2.5) among all the juices tested.

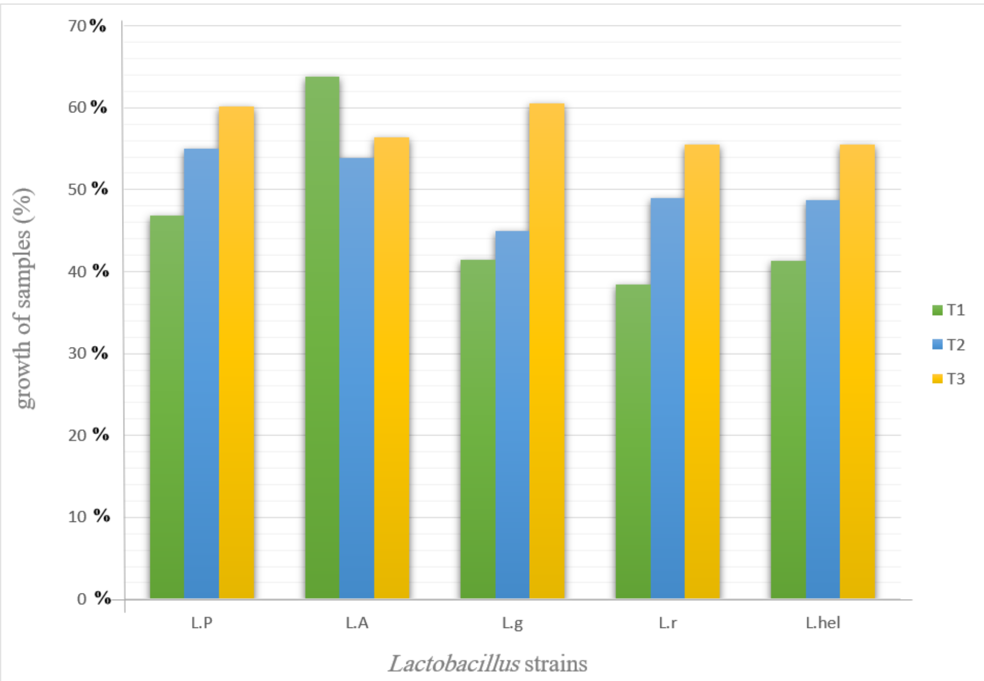

Figure 1: The growth of probiotic bacteria of pomegranate jelly

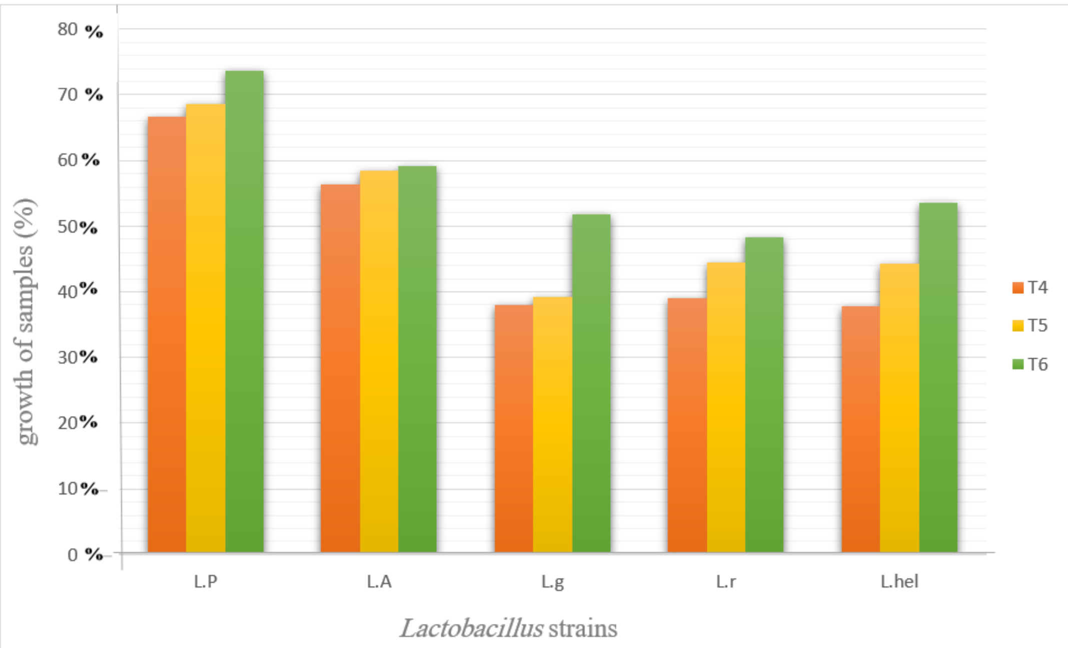

Figure 2: The growth of probiotic bacteria of guava jelly

CONCLUSION

From the results, we can be concluded that WP can add to fruits jelly as the major ingredient for producing acceptable jelly confection. Because fruits jelly with WP have rich in protein content and have a positive effect on the growth rate on strains of *Lactobacillus.* Also, the percent of growth rate was increased when increased the percent in WP. fruits jelly with WP it can be in the hospitals of the kingdom of Saudi Arabia. Because, many patients situated in hospital are given jelly (low nutritional value) as their stomach cannot handle anything else. As well, field in industry, we recommend use WP in many food products, such as ice cream and baby products. Furthermore, it can be added as fortifies in nondairy products like fruits jelly.

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