

Research Article

Characterization and Sensory Evaluation of Pomegranate Molasses Fortified with Wheat Germ

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Abstract: The aim of this study is to characterize Pomegranate Molasses (PM) fortified with the WG and to study the effect of standard storage conditions on sensorial and selected physicochemical properties. Preliminary studies showed that the best combination of WG is 6%. Proximate analysis, pH, total soluble solids and sensory evaluation were conducted for pomegranate fortified with WG. These parameters were measured after two months storage. The protein, ash and fat contents were significantly high ($p < 0.05$) in PM fortified with WG compared with those of PM. The overall acceptability of the fortified PM with 6% WG (GPM) indicated that the panelists scored the fortified PM significantly higher ($p < 0.05$) than those of PM. It can be concluded that 6% GPM can involve as nourished source to replace the PM as evidenced by their higher amounts in protein, fat and ash and it is significantly accepted by the taste panel.

Keywords: Fortification, pH, pomegranate molasses, proximate analysis, sensory evaluation, total soluble solids, wheat germ

INTRODUCTION

Wheat Germ (WG) considered being a byproduct of milling industry, it constitutes about 2-3% of the wheat grain and it can be separated in pure form from the grain during the milling process (Megahed, 2011). WG contains valuable nutritious and functional components; it is rich in proteins (25-30%) with high essential amino acids of arginine, lysine and threonine. It consists also 8-14% lipids, 3-5% minerals, 44-54% total carbohydrates and 1.5-4.5% crude fiber (Cornell, 2003; Zacchi *et al.*, 2006).

WG contains appreciable amounts of essential fatty acids and antioxidant in the form of tocopherols; the fatty acid profile showed that palmitic, oleic, linoleic and linolenic acids formed about 16.50, 15, 54.50 and 7.50% of total fatty acids, respectively. Interestingly, it has been reported that the level of α -tocopherol was found to be between 0.79-1.27 mg/g (Yuldasheva *et al.*, 2010; Kan, 2012).

WG serves as a cheap source of raw material for the food and oleochemical industries (Mahmoud *et al.*, 2015). It has been reported that the addition of 7% WG to a high fat cholesterol diet showed a beneficial effect on the lipid status of rats compared to those consumed low fat diet; whereas the addition of WG to the high fat cholesterol diet significantly increased the High Density Lipoprotein (HDL) cholesterol and the HDL serum cholesterol ratio and lowered the Very Low Density

Lipoprotein (VLDL) triglycerides (Lairon *et al.*, 1987). It has been shown that WG can be used to improve the quality and nutritive value of date syrup (Ammar, 2012). The total soluble solids, pH, consistency, total phenolic content and the antioxidant activity were increased as the concentration of the added wheat germ increased, while the color of the final product measured by CIE L* a* b* color values became lighter and attractive as the ratio of added WG increased (Ammar, 2012). Addition of WG at a ratio of 2% found to improve the composition, antioxidant activity and rheological characteristics as well as the sensorial properties of the by-product of the beverage industries such as sweet whey or butter milk (Abbas *et al.*, 2015).

Pomegranate molasses are sugar concentrates that consumed by Jordanian people, which is traditionally named "Debis". It is produced by concentration of pomegranate juice involving boiling in open vessels with or without addition of citric acid and consumed as a traditional dish especially in winter. Pomegranate molasses used as folk remedy for some illnesses such cancer, cardiovascular disease, diabetes, dental conditions, erectile dysfunction, bacterial infections and antibiotic resistance, as well as ultraviolet radiation-induced skin damage (Jurenka, 2008). Other potential applications include infant brain ischemia, male infertility, Alzheimer's disease, arthritis and obesity (Jurenka, 2008).

Pomegranate molasses are poor in protein as well as lipids especially unsaturated fatty acids, therefore and up to our knowledge, there was no previous attempt to fortify the pomegranate molasses with WG and because we believe that WG could be presented for human consumption promoting additional nutritive value, we suggest this current research. The aims of this study were:

- To determine the maximum acceptable added level of wheat germ in production of WG fortified pomegranate molasses.
- To study some chemical and physiochemical properties of pomegranate molasses after fortification with wheat germ.
- To evaluate the sensory attributes of the fortified pomegranate molasses at zero time and after two months of storage.

MATERIALS AND METHODS

Wheat germ and proximate analysis: Wheat germ was purchased from governmental mill, Amman/Jordan and proximately analyzed; where moisture, fat, protein and ash were determined according to AOAC (2000) procedures. Total carbohydrates content was calculated by difference.

Pomegranate molasses preparation: Pomegranate fruits were purchased from local market, washed, peeled, crushed and the fluid was extracted, filtered then concentrated using gentle heating in open vessel until 75% total soluble solids was measured using the refractometer.

Preliminary study: Preliminary study was carried out to adjust the highest sensory acceptable level of the added wheat germ to pomegranate molasses. Blends were carried out using different concentrations of wheat germ. Then the prepared pomegranate molasses were evaluated organolytically by 5 trained panelists chosen from the teaching staff and technicians of the Department of Nutrition and Food Technology, Al-Huson University College. The samples were evaluated for overall acceptability using a 9-hedonic scale test as described by Larmond (1991). The highest sensory acceptable level of added wheat germ was optimized at 6% (w/w). Accordingly, 6% (W/W) WG was added to pomegranate molasses. A control negative treatment was prepared at zero level of WG to conduct subsequent comparisons. Molasses were hot filled in glass containers of 250 g weight, closed tightly and stored at room temperature on the shelf for further analysis.

Proximate analysis: Pomegranate molasses with 6% WG was analyzed for proximate analyses including

moisture, fat, protein and ash following AOAC (2000) procedures. Analyses were carried out in duplicate. Total carbohydrates were measured by difference.

Determination of the total soluble solids: The total soluble solids were measured using the refractometer at zero time and after two months of storage at room temperature for the control sample and the one fortified with WG (GPM).

pH determination: The pH of the pomegranate molasses with 6% WG (GPM) and the control sample was determined using pH meter at zero time and after two months of storage at room temperature.

Sensory evaluation: Sensory characteristics were evaluated at zero time and after two months of storage at room temperature by 31 panelists chosen from the teaching staff, graduated students and technicians of the Department of Nutrition and Food Technology, Al-Huson University College. The panelists were from both sexes, with 19-50 years old, they were requested to taste each sample separately. The samples were evaluated for overall acceptability, appearance, taste, flavor, using a 9-hedonic scale test as described by Larmond (1991), where score 9, represents the "like extremely" and score 1 represents "dislike extremely".

Statistical analyses: Data were statistically analyzed, where standard deviation, means and ANOVA followed by Multiple Comparisons at $\alpha = 0.05$ were determined using Statistical Package for Social Science (SPSS version 20, SPSS (2010)).

RESULTS AND DISCUSSION

Proximate composition of wheat germ: Proximate analyses of wheat germ produced in Jordan as byproduct of wheat milling are shown in Table 1.

As shown from the above results wheat germ has appreciable amounts of protein (28%) and fat (9.5%), where both components are limited in produced molasses if it is not fortified. As mentioned previously, the average production of wheat germ in Jordan mills is about 18000 tons annually during the last five years meaning that we have about 5000 tons of protein and 1700 tons of oil that are not sufficiently utilized and the only usage of this valuable byproduct is as livestock feeding.

Ash content was 3.5% meaning that wheat germ also has good minerals content and could be utilized in fortification of mineral low content-food products. Moreover, the high content of the total carbohydrates is 46% enable this byproduct to be a high source of energy and dietary fiber. This finding will enable a good opportunity to utilize more than 8000 tons of carbohydrates annually. Moreover, low moisture

Table 1: Proximate composition of wheat germ*

| Characteristics | Percentage % |
|---------------------|--------------|
| Moisture | 13 |
| Protein | 28 |
| Fat | 9.5 |
| Ash | 3.5 |
| Total carbohydrates | 46 |

*Readings were presented as an average of duplicates

Table 2: Proximate analysis of pomegranate molasses*

| Characteristics | Percentage % | |
|---------------------|--------------------|----------------------|
| | PM | GPM |
| Moisture | 24.22 ^a | 23.14 ^{b**} |
| Protein | 0.36 ^b | 1.80 ^a |
| Fat | 0.0 ^b | 0.56 ^a |
| Ash | 3.52 ^b | 3.78 ^a |
| Total carbohydrates | 71.90 ^a | 70.71 ^b |

*Readings were presented as an average of duplicates; **Significant differences at $\alpha = 0.05$

percentage of 13% enhances the stability of wheat germ during storage against deteriorations.

These results obtained are coincide with those in different literatures (Cornell, 2003; Zacchi *et al.*, 2006; Megahed, 2011; Özcan *et al.*, 2013; Abbas *et al.*, 2015; Mahmoud *et al.*, 2015; Youssef, 2015).

Preliminary study and final treatment preparation:

Overall acceptability of the preliminary blends of pomegranate molasses with wheat germ showed that treatment with 6% WG has attributed as a best blend. Concentrations higher than 6% had lower scores that ranged under the categories of: “neither like nor dislike” to “dislike slightly”. Therefore, the treatment optimized to end up with 6% WG addition.

Proximate composition of pomegranate molasses:

Proximate analyses (Table 2) indicated a significant increment ($p \leq 0.05$) in protein, fat and ash of Pomegranate Molasses (PM) while decrement of moisture and total carbohydrates due to the addition of WG. Protein and ash contents in pomegranate molasses with wheat germ (GPM) increased by 400% and 7.4%, respectively. Fat was not detected in the control treatment of PM while addition of 6% WG increased the fat content from zero to 0.56%. These increments in protein, fat and ash are valuable since the ordinary PM lacks these nutritious food components.

Decrease moisture content by about 4.5% due to low moisture content of WG which was 13%, may participate in more stability of such products and increase its shelf life. Total carbohydrates decreased significantly ($p < 0.05$) as a result of the increase in other food components: the protein, fat and ash.

Total soluble solids: The Total Soluble Solids (TSS) of pomegranate molasses (Table 3) were 75.2°brix, while the addition of 6% WG will significantly ($p \leq 0.05$) increase the TSS to 76.2°brix by increment percentage of 1.6%. This could be due to high total solids of WG which known to be 87% as mentioned in literature.

Table 3: Total soluble solids and pH of pomegranate molasses*

| Characteristic | Time of storage (month) | Treatments | |
|----------------|-------------------------|--------------------|---------------------|
| | | PM | GPM |
| TSS | 0 | 75.2 ^c | 76.2 ^{b**} |
| | 2 | 75.8 ^{bc} | 77.4 ^a |
| pH | 0 | 3.6 | 3.8 |
| | 2 | 3.3 | 3.5 |

*Readings were presented as an average of duplicates; **Significant differences at $\alpha = 0.05$

Table 4: Sensory characteristics of pomegranate molasses*

| Characteristics | Average | | |
|-----------------------|-------------------|-------------------|---------------------|
| | PM | GPM | GPM 2 months |
| Appearance | 7.61 ^a | 7.52 ^a | 7.48 ^{a**} |
| Color | 8.06 ^a | 8.03 ^a | 7.94 ^a |
| Consistency | 7.77 ^a | 7.52 ^a | 7.87 ^a |
| Sourness | 7.55 ^a | 7.35 ^a | 7.55 ^a |
| Taste | 6.81 ^b | 8.06 ^a | 8.45 ^a |
| Flavor | 6.77 ^c | 7.52 ^b | 8.48 ^a |
| Sweetness | 6.65 ^b | 7.77 ^a | 8.39 ^a |
| Overall acceptability | 7.06 ^c | 7.99 ^b | 8.55 ^a |

*Readings were presented as an average of duplicates; **Significant differences at $\alpha = 0.05$

After storage for two months the TSS increased in both molasses samples of fortified PM (GPM) and the control (PM) recorded as 77.4 and 75.8, respectively, these changes maybe attributed due to the increasing of the solubility of solid matters in water phase by time. The increment in TSS of PM and GPM at the end of storage was 1.57% and 3.2%, respectively, in comparison at zero time.

pH: pH values as shown from Table 3 were of 3.6 and 3.8 for control and GPM, respectively. Addition of 6% WG had very slight effect on pH of the pomegranate molasses. This low pH of pomegranate molasses is due to organic acids such as citric, malic, tartaric, succinic, fumaric and ascorbic acid that are naturally present in pomegranate juice and molasses (Akpınar-Bayızit *et al.*, 2016; Tezcan *et al.*, 2009) and impart to preservation effect of this product. Storage time had slight effect on pH of the control sample and GPM which decreased to 3.3 and 3.5, respectively.

Sensory evaluation: Results of the sensorial evaluation in term of appearance, color, consistency, taste, flavor, sweetness, sourness and overall acceptability for both 6% GPM and PM samples at zero time and after two months of storage at room temperature using 9-hedonic scale are shown in Table 4.

There were no significant differences in appearance and color between all treatments. The color of PM is dark while WG is yellowish, when homogenized as 6%GPM, the WG color is totally masked by the molasses’s dark color, moreover using of 6%WG concentration didn’t affected the appearance of PM.

Consistency attribute was not significantly differ in both treatments and scored “like moderately”,

indicating that addition of 6%WG to PM has no effect on its consistency. Same results were obtained regarding the sourness, since there was no significant difference between all treatments which all ranked as “like moderately”, indicating that addition of 6%WG didn't affected sourness sensation by panelists.

Taste of GPM significantly scored higher than that scored for PM, indicating that addition of WG enhanced the taste of PM at 6% addition level. The evaluation of taste parameter of molasses with WG (GPM) scored “like very much”, while for PM scored nearly “like slightly”. These changes may be attributed to increased values of fat, protein and ash as results of 6% addition of WG. Storage of GPM also enhanced slightly the taste scores from 8.06 to 8.45, this could be as a result of increasing TSS during storage which may affect the taste of this product. Same evaluation was seen regarding flavor characteristics that has the same ranges of taste which also enhanced by addition of WG.

Sweetness significantly differ when WG was added to the PM, this could be resulted from sensation of the sweetness of the added WG which had high total carbohydrates contents (46%). Sweetness of PM evaluated in the range of “like slightly”, while GPM evaluated in the range of “like moderately” then moved to “like very much” after storage, which may be resulted from increased solubility of WG during storage.

Overall acceptability was significantly scored higher for 6% GWG either at zero time or after two months of storage compared with control sample (PM). PM received overall acceptability of “like moderately”, while GPM was ranked “like very much” for overall acceptability attribute.

CONCLUSION

Addition of wheat germ to pomegranate molasses improved its characteristics by enhancing protein, fat and ash contents, as well as sensory parameters. Therefore, it is recommended to fortify this product by wheat germ to enhance its functionality and overall acceptability. The optimal fortification level is recommended to be 6% as it is proved to be ranked as best combination.

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