J. Food and Dairy Sci., Mansoura Univ., Vol. 3 (11): 587 - 597, 2012

PHYSICOCHEMICAL AND SENSORY PROPERTIES OF INSTANT NOODLES FORTIFIED WITH POMEGRANATE PEEL

Sakr, Amany M. ; Hanan A. Hussien and Eman M. Salem
Food and Technology Res. Ins., Agric. Res.Centre, Giza.

ABSTRACT

Pomegranate peels are characterized by high levels of fibers, phenols, antioxidatents and minerals levels. The chemical composition indicates that the pomegranate peels contain 5.3% ash, 12.11% fibers and 58.38 g/100gm dietary fibers. The soluble part of the total amount of fibers is about 34.25%. Antioxidants activity of pomegranate peels was 90.14% RSA, while total phenol content reached 145 mg GAE/100gm.

The noodles were fortified with 2 and 5% pomegranate peels powder. The dietary fibers content of pomegranate peel noodles doubled as the pomegranate peels content reached 5% compared with control. The phenols content increase to 43.91 and to 48.30 when the pomegranate peels was added by 2% and 5% respectively. The antioxidant activity increased 2.15 folds and 3.66 folds, compared with control, after adding of 2% and 5% pomegranate peels respectively.

The addition of pomegranate peels significantly increased the water absorption, weight percent and volume compared with control. Noodles with pomegranate peels had higher sensory scores, except in firmness, in comparison with control.

The results obtained in this study suggest that acceptable noodles in terms of physicochemical and sensory properties could be produced by incorporating pomegranate peels into noodles up to 5%.

INTRODUCTION

Instant noodles are widely consumed throughout the world and it is a fast growing sector of the noodles industry. This is because instant noodles are convenient, easy to cook, low cost and have a relatively long-shelf-life (Owen, 2001). As there is an increasing awareness that health may be modified through diet, it has been a challenge for food scientists in finding more nutritious and healthy substitutes or alternatives to wheat flour for noodles product (Jayasena *et al.*, 2008). In 1940, spaghetti pasta was one of the first foods which the U. S. Food and Drug Administration (FDA) permitted vitamin and iron enrichment (Chillo *et al.,* 2008).Several authors have studied the effect of the addition of dietary fibers, vitamins, minerals and other natural sources to enhance spaghetti pasta quality (Kulkarni *et al.*, 2012).

In recent years, many attempts have been made to study natural antioxidants, particularly those of plant origin. The pomegranate (Punica granatum L.), which belongs to the Punicaceae family, is one of the oldest edible fruits and is widely grown in many tropical and subtropical countries. Recent studies by Tzulker *et al.* (2007) have demonstrated higher antioxidant capacity of the pomegranate peels as compared with the aril juice. The same author reported that the antioxidant capacity has been mainly attributed to the water-soluble polyphenols, anthocyanins, and hydrolysable tannins. Great

interest has recently been focused on the addition of polyphenols to foods and biological systems, due to their well-known abilities to scavenge free radicals, i. e. antioxidant power (Kulkarni *et al.*, 2012).
The objective of this study was to study the effect of added pomegranate peels, used to replace commercial antioxidants colours, on physico-chemical, cooking quality and sensory properties of cooked instant noodles.

MATERIALS AND METHODS

Raw Materials

Wheat flour (72% extraction) and Pomegranate fruit were purchased from local market in Cairo, Egypt.

Preparation of Samples

Pomegranate peels were rinsed with distilled water. The peels were dried at 60 °C for 12 hours, then milling using Moulinex mill machine, sieving and maintained at sealed packages until use.

Noodles Preparation

The wheat flour was fortified with 2 and 5% pomegranate peels powder. The samples were extruded in the form of 1.2mm diameter noodles standards using a single extruder. The noodles stands were cut into approximately 20 cm lengths and folded into block shapes. Noodles without addition of pomegranate peels powder were prepared as a control sample (Hou and Kruk, 1998). Each of the samples was prepared in triplicates. The noodles were then steamed for 15 min at 100°C followed by cooling to 25°C and deep frying in vegetables oil at 140-150°C for 1 min (Owen, 2001). Finally, the noodles were cooled to room temperature and packed in polyethylene bags.

Chemical Analysis

Pomegranate peels powder, wheat flour and noodles were analyzed for its moisture, ash, protein and fat according to the methods described in the AACC (2000). Nitrogen content as estimated by Micro-Kjeldhal method and was converted to protein by using a factor of 6.25. Carbohydrates are determined by difference.

Dietary fibers, soluble and insoluble dietary fibers contents were analyzed according to the methods described in the AOAC (1990).

Colorimetric Determination of Total Phenols:

The amount of total polyphenols was determined in pomegranate peels using Folin-Ciocalteu reagent and calibrated against gallic acid. The results are presented as Gallic Acid Equivalent (mg GAE/100gm) (Singleton *et al*., 1999). All tests were conducted in triplicate.

DPPH Radical Scavenging Activity:

The 1,1 -diphenyl-2-picrylhydrazyl radical (DPPH) scavenging activity was determined using a modified method of Ohnishi *et al.*, (1994). The free radical scavenging activity of food extracts were tested, indicated as bleaching of the stable 1,1 -diphenyl-2-picrylhydrazyl radical (DPPH). A diluted extract of the right concentration, 0.15 ml, was added to 0.85 ml of the methanolic DPPH solution, 0.1 mM. The mixture was vertexed and allowed to

stand at room temperature. After 20 min, the absorbance was recorded at 517 mm. A control consisted of 0.15 ml of 95% aqueous ethanol and 0.9 ml of 0.1 mM DPPH solution. DPPH % scavenging activity (%SA) was calculated as %SA = (C-X) 100/C, where C is the absorbance of the control and X is the absorbance of the extract.

Colour Evaluation

The colour of dried noodles was measured with a Hunter Lab. Colorimeter (MiniScan XE Plus, Reston, VA) according to the method illustrated by (Gallegos-Infante *et al.*, 2010). Briefly, noodles samples were milled and sieved (0.425 mm mesh). Powder samples were placed in the colorimeter and the colour readings expressed by Hunter L*, a* and b* values. The color values were recorded as L* = lightness (0 = black, 100 = white), a* (-a* = greenness, +a* = redness) and b* (-b* = blueness, +b* = yellowness).

Results were expressed as colour differential (ΔE) between control noodles with 0% of pomegranate peels(PP) and substituted noodles, calculated as follows:

$\Delta E = \sqrt{(\Delta L)^2+(\Delta a)^2+(\Delta b)^2}$

where ΔL was calculated as: $\Delta L_{sample} - \Delta L_{control}$;

Δa was calculated as: $\Delta a_{sample} - \Delta a_{control}$;

and Δb was calculated as: $\Delta b_{sample} - \Delta b_{control}$.

Determination of Cooking Quality:

Tap water (about 1 liter) was brought to a boil in a two liter saucepan with the lid on to prevent any water loss. When the water started boiling, a 100g of noodles were added. The cooking temperature was maintained at 98 – 100º C throughout the cooking process. The cooking period began as soon as the noodles were put into the boiled water and cooked for 3, 6 and 9 min. the noodles were then removed from the saucepan, rinsed and cooled in running cold tap water for 1 min. cooking loss was measured by evaporating the cooking water to dryness in oven at 100º C according to (AACC, 2000)

Sensory Evaluation of Cooked Noodles:

The sensory evaluation was carried out in order to get consumer response for overall acceptability of the 2 and 5% pomegranate peels incorporated instant noodles compared to the traditional noodles. The noodles samples were cooked as described before. Panelists from Food Technology Research Institute, Agricultural Research Center evaluated texture, taste, color, and overall acceptability according to the method of (Jayasena *et al.,* 2008).

Statistical Analysis

Statistical analyses were carried out by SPSS10 program. Data were expressed as means ± SEM and the Statistical analysis was performed using one-way analysis of variance followed by Duncan's tests (SPSS, 2000).

RESULTS AND DISCUSSION

Chemical Composition of Ingredients

Pomegranate is one of the oldest edible fruits grown widely in many tropical and subtropical countries and is an important fruit plant in these regions It is extensively cultivated in Iran, Spain and Egypt among other countries. Fruits and peels of pomegranate have been commonly used in herbal medicine by local healers in many countries (Reddy *et al.*, 2007).

Table (1): The Chemical Composition of the Used Ingredients (on dry weight basis)

Chemical Composition	Flour (72% ext.)	Pomegranate Peels
Protein (%)	10.35±0.05	3.80±0.08
Ash (%)	0.49±0.01	5.30±0.10
Fat (%)	1.05±0.03	1.06±0.01
Carbohydrates (%)	87.44±0.53	71.42±0.59
Total Fibers (%)	0.47±0.01	12.11±0.32
Dietary Fibers (gm/100gm)	2.65±0.06	58.38±0.25
Soluble Dietary Fibers (gm/100gm)	1.06±0.05	20.01±0.09
Insoluble Dietary Fibers (gm/100gm)	1.59±0.08	38.37±0.07

The chemical composition of dried pomegranate peels is presented in Table (1). Chemical composition of dried peels was approximately in line with findings of Mirzaei-Aghsaghali *et al.*, 2011; Taher-Maddah *et al*., 2012 and Ullah, *et al*., 2012. The pomegranate peels are very rich in ash (5.3%), Taher-Maddah *et al*., 2012 and Ullah, *et al*., 2012 reported ash content to be between 4 and 5.4%.As for fibers, it was 12.11% compared with 13% in the studies by Mirzaei-Aghsaghali *et al.*, 2011 and Taher-Maddah *et al*., 2012. Also it can be noticed that the pomegranate peels have a high content of dietary fibers (58.38 g/100gm), the soluble part is about 34.25% of the total amount of fibers. On the other hand, protein and carbohydrate are lower in pomegranate peels than wheat flour. The variation in chemical composition of peels from other researchers work may be due to different growing conditions (such as geographic, seasonal variations, climatic conditions and soil characteristics), and extent of foreign materials, impurities, varieties, different processing and measuring methods (Taher-Maddah *et al*., 2012).

Wheat flour which is usually used to make instant noodles is low in fiber and protein content. The results obtained for wheat flour are in good agreement with the earlier results reported by (Kulkarni *et al.*, 2012). Protein and carbohydrate are high in wheat flour (10.35 and 87.44, respectively). While fiber (0.47 g/100gm) and ash (0.4958.38 g/100gm) are much lower than pomegranate peels.

Table (2): Determination of the Total Phenols, Radical Scavenging Activity (RSA) Antioxidant Activity and Minerals of Ingredients (on dry weight basis)

Treatment	Flour (72% ext.)	Pomegranate Peels
Total phenols (mg GAE*/100gm)	3.70±0.02	145.64±
Radical Scavenging Activity (%RSA)	65.00±0.05	90.14±
Fe (mg/100gm)	1.50±0.04	205.05±
Zn (mg/100gm)	0.45±0.01	37.11±
Ca (mg/100gm)	97.04 ±0.03	280.27±

***GAE: Gallic Acid Equivalent**

Table (2), shows the phenols, antioxidants, iron, zinc and calcium content in both ingredients. Total phenols of pomegranate peels were in contrast with the values in other studies by Shabtay *et al*. (2008), who reported that total phenols was about 140 mg/100 gm. The variation in phenolic content and antioxidant activity is likely due to the differences in local production area because the production of phenolic compounds is affected by sun light (Elfalleh *et al*., 2009).

Antioxidant activity of pomegranate peels was determined as percent antioxidant activity; the value was in the same line with Tehranifar *et al.* (2011).

The iron, zinc and calcium content of pomegranate peels is in range of studies found by Ullah, *et al*. (2012) who reported that Fe between 41-226.0 mg/100g and Zn between 49.0-136.0 mg/100g. The Ca content is higher than that reported by El-Magraby, (2003) who reported Ca was 229 mg/100gm.

Chemical Composition of Instant Fried Noodles

Pomegranate peels which is a by-product obtained in excess amounts in pomegranate juice processing plants and rich source of nutrients especially fiber and minerals (Ullah *et al.*, 2012).

Table (3): The Chemical Composition of Instant Noodles Produced by Flour (72% ext) and Pomegranate Peels (on dry weight basis)

Treatment	Control	Noodles with 2% Pomegranate Peels	Noodles with 5% Pomegranate Peels	LSD
Moisture	3.9±0.03 ^{a}	3.34±0.04^{b}	3.26±0.05^{c}	0.01
Protein (%)	11.80±0.04 ^{a}	11.50±0.02 ^{b}	11.12±0.04 ^{c}	0.02
Ash (%)	1.77±0.02 ^{a}	1.82±0.01 ^{b}	2.22±0.01 ^{c}	0.01
Fat (%)	18.26±0.01 ^{a}	16.20±0.03 ^{b}	15.26±0.01 ^{c}	0.02
Carbohydrates (%)	62.98±0.05^{a}	63.48±0.01 ^{b}	62.60±0.05 ^{c}	0.02
Total Fibers (%)	1.97±0.02^{a}	3.66±0.05 ^{b}	4.76±0.01 ^{c}	0.02
Dietary Fibers (gm/100gm)	2.65±0.01^{a}	4.15±0.01 ^{b}	5.72±0.04 ^{c}	0.01
Soluble Dietary Fibers (gm/100gm)	1.06±0.02^{a}	1.58±0.04 ^{b}	2.11±0.03 ^{c}	0.01
Insoluble Dietary Fibers (gm/100gm)	1.59±0.03^{a}	2.57±0.02 ^{b}	3.61±0.02 ^{c}	0.01
Energy	460.74±0.01^{a}	445.72±0.03 ^{b}	434.94±0.04 ^{c}	0.02

The chemical compositions of instant noodles are also presented in Table (3). The values are in contrast with those of Kulkarni *et al.* (2012). Moisture content was the highest in control noodles. The increase in pomegranate peels level led to decrease the moisture contents of noodles. Similar result was reported when garbanzo bean flour addition to obtain uniform noodles dough (Eyidemir and Hayta, 2009). From the same table, it can be noticed that the addition of pomegranate peels (which has a high ash content) slightly increased the ash content in the produced noodles. There is a slight non-significant difference in protein content as the pomegranate peels is poor in protein only (3.8gm/100gm), as shown in Table (1).

It can be noticed also, that there is a high increase in fibers content with the increased amount of pomegranate peels added. The dietary fibers content of pomegranate peels noodles doubled as the pomegranate peels content reached 5%. This is due to the high fibers content of pomegranate peels which also, contains high amounts of dietary fiber (58.38g/100gm), as shown in Table (1). This high fibers content caused the decrease in fat content, which was mainly absorbed in frying, (Ang, 1993). This leads to a decrease in energy of the noodles.

Table (4): Determination of the Total Phenols, Antioxidant Activity and Minerals of Dry Instant Fried Noodles (on dry weight basis)

Treatment	Control	Noodles with 2% Pomegranate Peels	Noodles with 5% Pomegranate Peels	LSD
Total phenols (mg GAE/100gm)	38.06±0.02 [a]	43.91±0.01 [b]	48.30±0.05 [c]	0.02
Radical Scavenging Activity (%RSA)	15.58±0.02 [a]	33.59±0.04 [b]	57.14±0.02 [c]	0.02
Fe (mg/100gm)	1.90±0.05 [a]	1.97±0.02 [b]	2.10±0.02 [c]	0.02
Zn (mg/100gm)	1.60±0.05 [a]	1.70±0.02 [b]	1.92±0.03 [c]	0.03
Ca (mg/100gm)	87.00±0.05 [a]	90.39±0.03 [b]	92.47±0.02 [c]	0.20

Table (4), shows the phenols, antioxidants, iron, zinc and calcium content of noodles. The phenols content of control noodles was 38.06 which is higher than that in the study by Kasetsart, (2009), which was 32.09 mg GAE/100gm. The phenols content significantly increase to 43.91 and to 48.30 when the pomegranate peels was added by 2% and 5% respectively. The increase in total phenols is due to the high content of phenols in pomegranate peels.

The antioxidant activity of control noodles is found to be 15.58% compared with the findings by Kasetsart, (2009), who found that the antioxidant activity was 16.09%. The antioxidant activity increased 2.15 folds by the addition of 2% pomegranate peels; while the increase of pomegranate peels to 5% increased the antioxidant activity by 3.66 folds. The increase in antioxidant activity is due to the addition of pomegranate peels which has a high content of antioxidants.

The increase of iron, zinc and calcium content of noodles may be due to the high level of these minerals in pomegranate peels (Ullah *et al.*, 2012).

Color Evaluation

From the data presented in Table (5), it is observed that the L*, a* and b* values of colour measurements for raw materials and noodles. The L* value (Lightness) of the noodles with pomegranate peels decreased as the quantity of the pomegranate peels in the noodles increased.

All the noodles prepared from wheat flour mixed with the pomegranate peels had higher a* and b* values and lower L* values than the control (L* = 79.70, a* = -1.35, b* = 20.92) due to the darker color of pomegranate peels (L* = 91.76, a* = 40.06, b* = 22.37) than wheat flour (L* = 88.64, a* = 0.11, b* = 12.79). The pomegranate peels fortified noodles were significantly more red, more yellow and darker than the control. Our findings are in agreement with results obtained by Eyidemir and Hayta, (2009), who studied apricot kernel noodles, and found that an increase of apricot kernel flour in pasta noodles enhanced the colour change.

Table (5): The Color Measurements of Ingredients and Dry Instant Fried Noodles

Treatment	L*	a*	b*	ΔE
Flour (72% ext.)	88.64±0.01	0.11±0.03	12.79±0.02	-
Pomegranate Peels	91.76±0.02	40.06±0.01	22.37±0.03	-
Control	79.70±0.01	-1.35±0.02	20.92±0.03	-
Noodles with 2% Pomegranate Peels	61.71±0.03	2.63±0.01	21.17±0.01	18.43±0.02
Noodles with 5% Pomegranate Peels	57.96±0.01	1.96±0.03	19.86±0.04	22.02±0.02

Cooking Properties of Noodles:

Noodle cooking quality could be estimated from cooking attributes such as weight increase percent, volume and cooking loss (Özkaya *et al.*, 1984). The effect of pomegranate peels addition on the cooking properties of noodles is presented in Table (6).

Table (6): Cooking Properties of Dry Instant Fried Noodles:

	Control	Noodles with 2% Pomegranate Peels	Noodles with 5% Pomegranate Peels
Cooking time	**2 min**		
Weight Increase %	103.6	119	125.7
Volume Increase %	33.3	46.6	50
Cooking Loss %	5.36	7.10	9.19
Cooking time	**3 min**		
Weight Increase %	147.3	155	214.8
Volume Increase %	53.3	100	160
Cooking Loss %	6.57	9.70	11.70
Cooking time	**6 min**		
Weight Increase %	170.5	206.2	305.7
Volume Increase %	100	166.6	180
Cooking Loss %	9.22	11.11	15.52

The results in table (6) indicated that the percent of weight increase was the lowest in control noodles. The addition of pomegranate peels led to an increase in the percent of weight (103.6%, 119% and 125.7% for control, noodles with 2% pomegranate peels and noodles with 5% pomegranate peels, respectively). The addition of pomegranate peels had a positive effect on water absorption evidence by a significant difference in uncooked to cooked weight ratio due to the increase in dietary fibers content of pomegranate peels noodles. These results are in agreement with data reported by Gallegos-Infante *et al.* (2010). Also, the increase in cooking time had the same effect of the uncooked to cooked ratio. Other studies showed that cooked weight of noodles increase when cooking time increased (Izydorczyk *et al.*, 2004).

The results showed that the percent volume of cooked noodles varied from 33.3 to 50% (for control, and control with 2% and 5% pomegranate peels noodles, respectively), after cooking for 2 min, the addition of pomegranate peels caused an increase in volume.

Cooking loss for good quality pasta should be lower than 12% (Hoseney, 1999). The cooking loss values were lower than 12% except when 5% pomegranate peels was added after 6 min cooking. Ingredients other than wheat flour such as pomegranate peels may cause discontinuity in gluten network (Gallegos-Infante *et al.*, 2010) resulting in more leaching out of solids from pasta into the cooking water. Izydorczyk *et al.*, (2004), stated that cooking loss could be attributed to weak protein-starch due to the presence of high soluble dietary fibers content in pomegranate peels.

Sensory Evaluation:

The effect of pomegranate peels addition in levels of 2% and 5% on sensory properties of noodles is shown in Table (7).

Table (7): The Sensory Evaluation of Noodles:

Treatment / Sensory	Control	Noodles with 2% Pomegranate Peels	Noodles with 5% Pomegranate Peels	LSD
Appearance	8.70±0.87 [a]	8.80±0.53[b]	9.25±0.49 [c]	0.03
Taste	8.55±0.45 [a]	8.70±0.62 [b]	9.08±0.33 [c]	0.03
Colour	8.33±0.53 [a]	8.93±0.65 [b]	8.65±0.26 [c]	0.05
Odour	8.80±0.63 [a]	9.02±0.41 [b]	9.20±0.25 [c]	0.04
Firmness	9.00±0.66 [a]	8.85±0.76 [b]	8.50±0.17 [c]	0.15
Total acceptability	8.67±0.63[a]	8.86±0.59 [b]	8.94±0.30 [c]	0.01

The results indicated that noodles with pomegranate peels had higher, significant, sensory scores, except in firmness, in comparison with control.

A reduction in sensory firmness value was obtained by increasing level of pomegranate peels in noodles, due to the increase in pomegranate peels. The same results were obtained by Eyidemir and Hayta, (2009) in their study on apricot kernel flour noodles since gluten has been reported to be responsible for firmness of noodles. Pomegranate peels fortified noodles had

a significant higher taste scores than control and the taste score increased with the increase of pomegranate peels level.

The total acceptability value had a significant increase as pomegranate peels content increased.

Conclusion

This study suggests using pomegranate peels as a source of natural antioxidant and dietary fibers in the manufacturing of instant noodles.

Therefore, pomegranate peels could successfully be used to enrich noodles, giving alternative utilization opportunity to producers and healthy choice option to the consumers.

REFERENCES

AACC (2000). AACC international approved methods of analysis (10thed). St. Paul, M.N., USA: American Association of Cereal Chemist.

Ang, J. F. (1993). Reduction of fat in fried batter coatings with powdered cellulose. *JAOCS*, 70 (6), 619-622.

AOAC. (1990). Official Method of Analysis. 15th Edn. Washington DC. USA, Association of Official Analytical Chemists. pp. 66-88.

Chillo,S.; Laverse, J.; Falcone, P.M; Protopapa, A. and Del Nobile, M.A. (2008). Influence of the addition of buck wheat flour and drum wheat bran on spaghetti quality. *Journal of Cereal Science,* 47(1): 144-152

Elfalleh, W; Nasri, N.; Marzougui, N.; Thabti, I.; M'rabet, A.; Yahya, Y., Lachiheb, B.; Guasmi, F. and Ferchichi, A. (2009). Physico-chemical properties and DPPH-ABTS scavenging activity of some local pomegranate (Punica granatum) ecotypes. *Int. J. Food Sci. Nutr*. 60 (2):197–210

El-Magraby, L. A. (2003). Technological and chemical studies on drying concentration and preservation of pomegranate fruit products. PhD thesis, Faculty of Agriculture, Cairo University, Egypt.

Eyidemir, E. and Hayta, M. (2009). The effect of apricot kernel flour incorporation on the physicochemical and sensory properties of noodle. *African Journal of Biotechnology*, 8 (1), 85-90.

Gallegos-Infante, J.A.; Rocha-Guzman, N.E.; Gonzalez-Laredo, R.F.; Ochoa-Martnez , L.A.; Corzo, N.; Bello-Perez , L.A.; Medina-Torres , L. and Peralta-Alvarez, L.E. (2010). Quality of spaghetti pasta containing Mexican common bean flour (Phaseolus vulgaris L.) *Food Chemistry* 119, 1544–1549.

Hoseney, C. (1999). Principles of cereal science and technology (pp. 269–274). St. Paul, MN, USA: *American Association of Cereal Chemists*.

Hou, G. and Kruk, M. (1998). Asian noodle technology, Technical Bulletin 20(12), 1-10.

Izydorczyk, M.S.; Lagasse, S.L.; Hatcher, D.W.; Dexter, J.E. and Rossnagel, B.G. (2004). The enrichment of Asian noodles with fiber-rich fractions derived from roller milling of hull-less barley. *J. Sci. Food Agric.* 85, 2094-2104.

Jayasena, V.; Leung, P. and Nasar-Abbas, S. M. (2008). Lupins for health and wealth. *Proceedings of the 12th international Lupin conference*, 13-18 sept. 2008, fremantle, Western Australia. International Lupin association, Canterbury, New Zealand. ISBN 0-86476-153-8.

Kasetsart, J. (2009). Development of Instant noodles made from composite flour of wheat and sweet potato flours. *Nat. Sci*, 43:768-779.

Kulkarni, S. S.; Desai, A. D.; Ranveer, R. C. and Sahoo, A. K. (2012). Development of nutrient rich noodles by supplementation with malted ragi flour. *International Food Research Journal,* 19(1): 309-313.

Mirzaei-Aghsaghali, A.; Maheri-Sis, N.; Mansouri, H.; Razeghi, M. E.; Mirza-Aghazadeh, A.; Cheraghi, H. and Aghajanzadeh-Golshani, A. (2011). Evaluating potential nutritive value of pomegranate processing by-products for ruminants using in vitro gas production technique. *ARPN J. Agr. Biol. Sci*, 6, 45-51.

Ohnishi, M.; Morishita, H.; Iwahashi, H.; Toda, S.; Shirataki, Y.; Kimura, M. and Kido, R. (1994). Inhibitory effects of chlorogenic acids on linoleic acid peroxidation and hemolysis. *Phytochemistry,* 36: 579-583.

Owen, G. (2001). Cereal Processing Technology. Cambridge: woodhead publishing.

Özkaya, H.; Seçkin, R. and Ercan, R. (1984). Bazı makarna çe_itlerinin kimyasal bile_imi ve pi_me kalitesi üzerine ara_tırma. *Gıda*. 9:133-161.

Reddy, M.; Gupta, S.; Jacob, M.; Khan, S. and Ferreira, D. (2007). Antioxidant, antimalarial and antimicrobial activities of tannin-rich fractions, ellagitannins and phenolic acids from Punica granatum L. *Planta Medica* 73, 461–467.

Shabtay, A., Eitam, H., Tadmor, Y., Orlov, A., Meir, A., Weinberg, P., Weinberg, Z.G., Chen, Y., Brosh, A., Izhaki, I., Kerem, Z. (2008). Nutritive and Antioxidative Potential of Fresh and Stored Pomegranate Industrial Byproduct as a Novel Beef Cattle Feed. *J. Agric. Food Chem.*, 56, 10063–10070.

Singleton, V. L.; Orthofer, R. and Lamuela-Raventos, R. M. (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin Ciocalteu reagent. *Methods Enzymol.*, 299, 152–178.

SPSS (2000). Statistical package for Social Sciences. SPSS for Windows, Version 10, SPSS Inc., Chicago, IL, USA.

Taher-Maddah, M.; Maheri-Sis, N.; Salamatdoustnobar, R. and Ahmadzadeh, A. (2012). Comparing nutritive value of ensiled and dried pomegranate peels for ruminants using in vitro gas production technique. *Annals of Biological Research*. 3(4):1942-1946.

Tehranifar,A; Zareia, M.; Nematia, Z.; Esfandiyaria, B. and Vazifeshenasb, M. R. (2011). Investigation of physico-chemical properties and antioxidant activity of twenty Iranian pomegranate (Punica granatum L.) cultivars. *Scientia Horticulturae*, 126, 180–185.

Tzulker, R.; Glazer, I.; Bar-Ilan, I.; Holland, D.; Aviram, M. and Amir, R. (2007). Antioxidant activity, polyphenol content, and related compounds in different fruit juices and homogenates prepared from 29 different pomegranate accessions. *J. Agric. Food Chem.*, 55, 9559–9570.

Ullah, N.; Ali, J.; Khan, F.; Khurram, M.; Hussain, A.; Inayat-ur-Rahman, Z. and Shafqatullah (2012). Proximate Composition, Minerals Content, Antibacterial and antifungal Activity Evaluation of Pomegranate (Punica granatum L.) Peels Powder. *Middle-East Journal of Scientific Research*, 11 (3), 396-401.

الصفات الفيزوكيميائيه و الحسيه للشعرية جاهزة التحضير المدعمة بقشر الرمان

امانى محمد صقر، حنان عبد الحميد حسين و ايمان محمد سالم
مركز البحوث الزراعية - معهد بحوث تكنولوجيا الأغذية

يتميز قشر الرمان بإرتفاع نسبه الالياف والفينولات وكذلك إرتفاع مضادات الاكسده و مستوى الاملاح المعدنيه. وقد أوضح التحليل الكيميائى ان قشر الرمان يتميز بأرتفاع نسبه كل من الرماد حيث كانت نسبته 5.3% و الالياف 12.11% كما ان محتوى الالياف الغدائيه يصل إلي 58.38جم/100جم و الالياف الذائبه 34.25% تقريبا من قيمه الالياف الكليه . بالنسبه لمضادات الاكسده كانت نسبتها 90.14% و محتوى الفينولات كان 145مجم/ 100جم. وقد زادت نسبه الالياف الغدائيه فى الشعريه جاهزة التحضير المنتجه باستبدال 2% و 5% من مسحوق قشر الرمان حيث وصلت ضعف العينه الكنترول خاصه فى العينه المضاف إليها 5% اما محتوى الفينولات فقد زاد الى (43.21 ، 48.30) مجم/100جم باضافه 2% ،5% على التوالى وبالنسبه لمضادات الاكسده فقد زادت نسبتها إلى 2.15، 3.66 ضعف مقارنه بالكنترول فى النسبتين 2% و 5% .

أدت زياده قشر الرمان إلى زياده معنويه فى الماء الممتص و كذلك النسبه المئويه للوزن و الحجم مقارنه بالكنترول وقد اكدت الاختبارات الحسيه ارتفاع جميع معدلات الشعريه المدعمه فيما عدا الثبات مقارنه بالكنترول . وتوصى الدراسه نتيجه للدراسات الفيزوكيميائيه و الحسيه بعدم إضافه قشر الرمان إلى الشعريه بنسبه تزيد عن 5% حيث تؤدى إلى تدهور صفات العجين.

بتحكيم البحث

أ.د / ممدوح محمد ربيع	**كلية الزراعة – جامعة المنصورة**
أ.د / سعيد محمد منصور	**مركز البحوث الزراعية**