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CHEMICAL AND TECHNOLOGICAL STUDIES ON MACARONI PRODUCATION FORTIFIED WITH FIBER AND PROTEIN BY-PRODUCTS

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ABSTRACT: *The present investigation aimed to assess the possibility of using some fruits and vegetable wastes including tomato peels, guava seeds, pomegranate peels and orange pulp as different sources of dietary fiber. Dietary fiber from tomato peels, guava waste, pomegranate peels and orange pulp were used in preparation macaroni fortified fiber and protein at the levels of 2.5,5 and 7.5% dietary fiber. The results showed that the pomegranate peels contained a high percentage of fiber, ash and protein .For organoleptic properties, the levels 2.5 and 5 % of guava waste , orange pulp and tomato peels were the best levels except in case of pomegranate peels it was 2.5 %.*

The extensibility of the dough decreased in case of guava waste followed by pomegranate peels, tomato peels, and orange pulp which were recorded the lowest decrease. Whereas maximum resistance to extension increased in case of pomegranate peels, orange pulp, and guava waste. Regarding to the rheological properties of the wheat flour72% utilized in preparing macaroni samples, the addition of the wastes dietary fiber at high levels lead to an increase in the water absorption and arriveal time while the dough development and weakening dough were decreased. Cooking properties of the produced macaroni with2.5% of tomato peels, guava waste, pomegranate peels and orange pulp, showed an increase in percentage of weight increase and percentage of volume increase except macaroni with 2.5% pomegranate peels which occurred an decrease in the percentage of volume as compared to macaroni without additives (control). Fortifi of macaroni with pomegranate peels and orange pulp were associated with increased of protein, fiber and ash cations may due to increase the nutrients in pomegranate and orange pulp.

Key words: *Fruits and vegetable wastes- Tomato peels- Guava waste-Pomegranate Peels-Orange pulp–Rheological Properties –Cooking Properties.*

INTRODUCTION

The by-products from food industry and processing is one of factories which caused the environmental pollution because of the offensive odors they from, and the growth of harmful microorganisms which lead to the putrefaction and they hydrolysis of the media, and of harmful insect. Nevertheless, it should be noted that many by- products considered specially in fruit processing i.e. process jams, syrups, nectars and juices, tomato peels, pomegranate peels, guava waste and orange pulp are found in large amounts as by- products in processing factories of fruits as tomato paste and fruit juice. Guava seeds play an important role in the bakery products as food additives. They are low in fat and good source of dietary fiber, protein and a variety of micronutrients and phytochemical (Messina 1999).

Pomegranate peels contains a higher amount of protein, dietary fiber and minerals, which have been shown to have therapeutic activity and food supplementation as a good source of the above nutrients (Bundin, 2003).

Citrus is the most abundant crop in the world, 63.95 million tons of orange were produced during 2004. The amount of residue obtained from citrus fruits account for 50% of the original amount of whole fruit (Chon and Chon 1997, Laufenberg *et al.,* 2003).

Many developing countries have nutritional problems and produce excess of by- product materials rich in carbohydrates. In the wake of technological advancement. By – product accumulation has assumed serious dimensions not only in the western world but also in the third world countries. Over the years there have been considerable efforts to develop techniques for the recovery and utilization of the biopolymers in the by- products. This became necessary considering the fact that those by-products contain appreciable quantities of dry matter, crude protein, fiber, ether extract, minerals and high molecular weight cellulose and hemicelluloses and could be obtained at minimal cost *(*Konlani *et al.,*1996, Nwabueze and Nwabueze, 2001).

The by-products are very important for health it provide protection against cancer and other degenerative diseases, influenced by free radical reaction, the results revealed that the dietary fiber from by-products reduced glucose absorption and cholesterol levels, the specific properties of dietary fiber from by-products play an important role in the prevention and treatment of obesity, atherosclerosis, coronary heart diseases, colorectal cancer and diabetes, by products helped in the maintenance of prostate health *(*Drzikova *et al.,* 2005*)*.

The word pasta is a generic term used in reference to the whole range of products commonly known as spaghetti, macaroni, vermicelli and noodles. Pasta is the second to bread in world consumption, It's nearly wide acceptance is attributes and long shelf life (Raimondo *et al.,* 2007). Kratzer *et al.* (2008) showed that, pasta is currently at the top of food consumption charts in the world. There are many types of pasta, differing mainly in size and shape. But also in the quality of the mix which may be plain or enriched with egg or soya flour .Typical shapes are the tubular forms, and cut-out shapes. In the western countries dry pasta products are preferred. They are simple to make and can be stored for long periods, but in Eastern countries there is a preference for various forms of wet and dry noodles (Feillet and Dexter,1996).

Recent interest in dietary fiber has arisen from epidemiological observations which linked to the lack of fiber in the diet with the prevalence of certain degenerative diseases in industrial societies (Jenkins *et al.,* 2002*).*

NHANES *(*National Health and Nutrition Examination Survey, 2004), found that 23.07% of men and 26.0% of women aged 20-74 on period (1998-2003) were obese. So, weight management has become a multibillion dollar industry the typical dieter likely to use low calorie foods and food high in fiber Ricarrdi *et .al,* (2006).

So, consumers in all of the world interest in whole- grain products especially whole-wheat pasta because they are recognized of its nutritionally balanced diet. Thus, food and food ingredients of high fiber is expected to continue the increasing volume. According to Mitel's Golbal new product database (2006), 48 new whole-grain pasta rolled into the grocery shelves in the first half of 2005, more than four times the number introduced in 2002 especially the diabetics and dietetics persons Walker *et. al. (*2007*).*

It is worth to mention that today's consumers hold high standers for the foods they consume. They demand foods that taste great and Calorie- reduced, and they are interested in food that provide added health benefits and become more concerned about consuming additional fiber . So, fiber could be used as an ingredient in bakery products to reduce calories and add possible health benefits (Abo-zeid,2002). However, for these products are riches with fiber, protein and ash .

MATERIALS AND METHODS.

Materials:

Wheat flour:

Wheat flour (72% extraction) used in this study was obtained from Wadi El-Molouk Co. for milling, Cairo, Egypt.

The different wastes sources were utilized in this study:

Pomegranate peels:

A by-product was purchased and collected from a well-known market in Shiben El Kom City, Minufiya Govenerate.

Tomato peels:

A by-product of Beverages and Juice industry (B & J) is derived from the peels in juice production. It was obtained from B.J Concentrated and Juice Company. 6th area, Sadat City, Minufiya Govenerate.

Orange pulp:

A by-product was purchased and collected from a well-known market in Shiben El Kom City, Minufiya Govenerate.

Guava waste:

A by-products of El-Aein industry is derived from the pulp and seeds in the beverages production. It was obtained from El-Aein Food and Beverages Company. 7th area, Sadat City, Minufiya Govenerate.

Methods:

Preparation of waste materials:

Pomegranate, tomato, orange and guava by-products were dried at 50ºC for 90 min using a fan oven. Then, they were milled by a precession mill to give powder.

Supplementation of macaroni:

In this study, Macaroni fortified with powder of pomegranate peels, tomato peels, orange pulp and guava pulp with different levels (2.5, 5 and 7.5 %).

Preparation of macaroni Homemade pasta:

To make pasta, addition of 100g of wheat flour 72% extraction with water to obtain a strong dough, then shaping by pasta machine (home machine) and drying on oven at 85^0C for 20 min. To prepare the control sample. The tested samples were prepared by adding 2.5, 5 and 7.5 % by-products to control sample by extension the weight of flour .

Analytical Methods:

The crude protein, fat, dietary fiber and ash were determined according to the methods of A.O.A.C. (1995). Total carbohydrates was calculate by difference .

Determination of Rheological Properties :

Brabender farinograph test:

Farinograph (type Brabender farinograph–Germany) test was performed to study the hydration and mixing characteristics of dough under investigation. The following reading were taken from the farinograph as described in A.A.C.C. (2002).

water absorption (%)

It is percentage of water required for the dough to have consistency of 500 B.U-line .

Arrival time (min):

It is the time in(min) required for the curve to reach the 500 brabender unite line after the mixer has been started and water was added.

Dough development time (min):

It is the time in minutes from the first addition of water to development of dough's maximum consistency.

Dough stability(B.U):

It is the time in minutes elapsing when the top of the curve interacts first 500 B.U. line leaves that line.

Weakling of dough (B.U):

It is consider by brabender units from leaving 500 B.U. line to the middle of the curve measured after 12 min.

Brabender Extensograph Test:

Extensograph test was carried out according to the method described by A.A.C.C. (2000) using an Extensograph (type Brabender Extensograph – west Germany) to determine the following:

Dough extensibility (E):

The total length of the base of the extensogram measured in millimeters .

Dough resistance to extension (R):

The height of the Extensograph curve measured in brabender units after 5 minutes from the start.

Cooking of macaroni:

Samples of different produced pasta (25g) were cooked in one liter of boiling

water for ten minutes as described by Grant *et. al,* (2004*).* The samples were washed thoroughly with distilled water and allowed to drain for two minutes.

Sensory evaluation of macaroni

The quality of cooked macaroni was evaluated by ten panelists from staff of Queen company at El-Sadat City, Minoufiya, Govenerate, Egypt. Cooked macaroni samples were organoleptically evaluated for Color, Oder, Flavor, Texture and Overall acceptability as shown in the evaluation was accomplisher according to the method, described by Watts *et. al.* (1989) and Dexter *et. al.* (1990).

Very good	8 & 9
Good	6 & 7
Fair	4 & 5
poor	2 & 3
Very poor	0 & 1

Determination of macaroni quality:

Cooking quality of macaroni was determined according to the method of Edwards *et. al.* (1993) as follows: Twenty five g of macaroni samples were transferred to macaroni laboratory and cooked containing 250 ml of boiling water (100 ^{0}C) and For 10 minutes .These measurements were determined.

Weigh increase (%)

This value was calculated as follows:
weigh increase =

$$\%\,weight\,increase = \frac{W1 - W}{W} \times 100$$

Where:

W = uncooked sample weigh (g)
W_1 = cooked sample weigh (g)

Volume increase % (Swelling increase %):

This value was calculated as follows:
Volume increase = (Volume of cooked sample – volume of uncooked sample × 100) / volume of uncooked sample

Cooking loss% (Total Soluble Solids, T.S.S):

Total soluble solids of cooking liquid were estimated according to method of Walsh and Gilles (1971), residue was determined by weight the solid materials in cooking water after drying in an oven at 130^{0}C over to a constant weight .

Result were recorded as follows :
Cooking loss (T.T.S) =

$$\frac{\text{Wight of residue in Cooking water} \times 100}{\text{Weight of uncooked sample}}$$

Statistical analysis:

The data were analyzed using a completely randomized factorial design (SAS,1985) when a significant main effect was detected, the means were separated with the student-Newman-Keuls test. Differences between treatments of < 0.05 were considered significant.

RESULTS AND DISCUSSION

Wheat flour, orange peel, tomato peels, pomegranate peels and guava waste were analyzed for their chemical composition i.e., carbohydrates, protein, fat, fiber and ash. The obtained results are shown in Table (1) on the dry weight basis.

From the results presented in Table (1), it could be noticed that the wheat flour 72% extraction contained 86.52%, 11.17%, 1.24%, 0.56%, and 0.51% carbohydrates, protein, fat, fiber and ash respectively. Concerning pomegranate peels, it was found to contain 13.43, 0.57, 16.78, 14.32 and 54.90 protein, fat, fiber, ash and carbohydrates respectively, while in case of guava waste contained 12.92, 7.65, 15.98, 13.76, and 49.69% of the same content, respectively.

On the other hand tomato peels contained 9.22, 0.45, 12.61, 10.15, and 67.57% protein, fat, fiber, ash and carbohydrates. While orange pulp contained 9.11, 3.12, 4.15, 6.89, and 76.73% of the same content respectively.

From these results, it could be noticed that, the guava waste contained the highest protein, fat, fiber and ash while orange pulp contained the highest carbohydrates.

Table (1): Chemical Composition of orange peel, Tomato peels, Pomegranate peels and Guava waste:

Constituents material	Protein %	Fat %	Fiber %	Ash %	Total carbohydrate %
Wheat fiour72%	11.17	1.24	0.56	0.51	86.52
Orange pulp	9.11	3.12	4.15	6.89	76.73
Tomato peels	9.22	0.45	12.61	10.15	67.57
Pomegranate peels	13.43	0.57	16.78	14.32	54.90
Guava waste	12.92	7.65	15.98	13.76	49.69

* on dry weight basis

These results confirmed those obtained by El- Badrawy (1994) who found that wheat flour 72% extraction contained 84.35% carbohydrates. 13.11 protein, 1.51% lipids and 4.15 fiber .

The nearly result were found also to agree with those of Block *et al.* (1973). They found were tomato by product contains 10.5% protein, and 0.5% ash. Kelawala and Anant (2004) who reported that orange by products contained 15.20 protein, fiber 20.12 and ash 16.01%.

- Organoleptic properties of macaroni supplementation with different additives.

A five member taste panel scored color, flavor, texture, and Overall acceptability of macaroni baked with 100% wheat flour and tomato peels, orange pulp, pomegranate peels and guava waste at levels of 2.5,5 and 7.5%as shown in Table (2).

Data from Table (2) show that all organoleptic properties for macaroni supplemented with 2.5, 5 and 7.5 of guava waste were highly significant.

Macaroni baked using wheat flour (control) alone were better in organoleptic qualities than that fortified with 7.5% of all (tomato peels, orange pulp, pomegranate peels and guava waste).

Data from Table (2) show that, all organoleptic properties for macaroni fortified with levels of 5% for tomato peels, 2.5 and 5%for pomegranate peels, 5%for orange pulp were significantly decrease as compared to control.

The best organoleptic properties for supplemented macaroni with 2.5, 5 and 7.5% of guava waste, 2.5% for tomato peels, 2.5% for pomegranate peels and 2.5% for orange pulp, because these treatments showed no significant changes in total scores as compared with the control. Such results were in agreement with those obtained by Orr *et. al.,* (1982).

Form the results presented in table (3), it could be noticed that extensibility of the dough and resistance to extension for Tomato Peels, Orange pulp, Pomegranate Peels and Guava Waste.

Form the results presented in table (3), it could be noticed that extensibility of the dough decreased from 250 mm for wheat flour alone to 210 mm for wheat flour containing 2.5% tomato peels powder, while increasing the addition for tomato peels to 5&10% caused a decrease in dough stability to 196 and 170 mm, respectively. Resistance to extension was found to be increased from 420 for wheat flour alone to 563 mm for wheat flour containing 2.5% tomato peels powder, while increasing the addition of tomato peels to 5 &7.5% caused a increase in dough resistance to (B.U) extension to 781 and 833 B.U, respectively.

Table (2): Organoleptic properties of macaroni with tomato peels, orange peels, pomegranate peels and guava waste.

Organoleptic	Control	Macaroni with different additives											
		Tomato peels			Guava waste			Pomegranate peels			Orange pulp		
Properties		2.5	5	7.5	2.5	5	7.5	2.5	5	7.5	2.5	5	7.5
Color	9^{a}	9^{a}	8^{a}	8^{a}	9^{a}	9^{a}	9^{a}	8^{a}	7.7^{b}	6^{d}	9^{a}	8.5^{a}	7^{b}
Odor	9^{a}	9^{a}	8^{a}	7^{b}	9^{a}	9^{a}	9^{a}	7^{b}	6^{d}	6^{d}	9^{a}	8.5^{a}	7^{b}
Flavor	9^{a}	9^{a}	8^{a}	7^{b}	9^{a}	9^{a}	9^{a}	7^{b}	6^{d}	6^{d}	9^{a}	8^{a}	7.5^{b}
Texture	9^{a}	9^{a}	8^{a}	7^{b}	9^{a}	8^{a}	8^{a}	8^{a}	7^{b}	6^{d}	9^{a}	7.5^{b}	6.7^{c}
Overall acceptability	9^{a}	9^{a}	8^{a}	7^{b}	9^{a}	8^{a}	8^{a}	8^{a}	7^{b}	6^{d}	9^{a}	7.5^{b}	6.7^{c}

Values denote arithmetic means ± stander deviation of the mean.
Means with different letters (a,b,c,d) in the same column differ significantly at p≤0.05 using one way Newman-Keuls test, while those with similar letters are nonsignificant.

Table (3): Extensograph Properties for Dough prepared form Flour Containing 0-10% different additives.

Blends (g)			Dough extensibility (mm)	Resistance to extension (B.U)
Control blend	100	0	250	420
Blend A Tomato peels	97.5	2.5	210	563
	95	5	196	781
	90	10	170	833
Blend B Guava waste	97.5	2.5	200	643
	95	5	166	681
	90	10	135	733
Blend C Pomegranate peels	97.5	2.5	200	634
	95	7	170	815
	90	10	145	957
Blend E orange pulp	97.5	2.5	237	531
	95	5	210	660
	90	10	190	798

In the same Table (3), it could be noticed that extensibility of the dough decreased from 250 mm for wheat flour alone to 200 mm for wheat flour containing 2.5% guava waste powder, while increasing the addition for guava waste to 5&7.5% caused a decrease in dough stability to 166 and 135 mm respectively. Maximum resistance to extension was found to be increased from 420 B.U for wheat flour alone to 643 B.U for wheat flour containing 2.5% guava waste powder, while increasing the addition of guava waste powder to 5 & 10% caused an increase dough resistance to (B.U) extension to 681 and 733 B.U, respectively.

Regarding the results presented in table (3), it could to be noticed that extensibility of the dough decreased form 250 mm for wheat flour alone to 200 mm for wheat flour containing 2.5% pomegranate peels powder, while increasing the addition for pomegranate peels powder to 5&7.5% caused a decrease in dough stability to 170 and 145 mm respectively. Maximum resistance to extension was found to be increased from 420 B.U for wheat flour alone to 634 B.U for wheat flour containing 2.5% pomegranate peels powder, while increasing the addition of pomegranate peels powder to 5 & 7.5% caused an increase dough resistance to (B.U) extension to 815and 957 B.U, respectively.

Form the results presented in Table (3), it could be noticed that extensibility of the dough decreased form 250 mm for wheat flour alone to 237 mm for wheat flour containing 2.5% orange pulp powder, while increasing the addition for orange pulp powder to 5&7.5% caused a decrease in dough stability to 210 and 190 mm respectively. . Maximum resistance to extension was found to be increased from 420 B.U for wheat flour alone to 531 B.U for wheat flour containing 2.5% orange pulp powder, while increasing the addition of orange pulp powder to 5&7.5% caused an increase dough resistance to (B.U) extension to 660 and 798 B.U, respectively.

From the above results, it could noticed that extensibility of the dough decreased in case of pomegranate peels followed by tomato peels, orange pulp and guava waste which recorded the lowest decrease . Whereas in case of maximum resistance to extension increase for pomegranate peels dough followed by tomato peels and the last one was guava seeds dough.

The extensibility of the dough decreased for all samples by increasing the maximum resistance to extension and was found to be increased by increasing the levels of nutritional wastes. Decreasing in dough extensibility and increasing in resistance to extension due to the shaped difficult during macaroni manufacture So, the best present mixing to peels were 2.5% of (tomato peels, orange pulp, pomegranate peels and guava waste).

Tomato Peels:

The result presented Table (4) showed the effect of addition of tomato peels to wheat flour 72% extraction on farinograph reading.

From these results, it could be noticed that of tomato peels to wheat flour increase in water absorption of the dough. It was increased from 58.7 to 62.5 for wheat flour with addition of 2.5 of tomato peels.

The results indicated also that addition of tomato peels to wheat flour caused a increase of arrived time and decreased in dough stability. Arrived time was found to be 2 min, dough stability was found to be 70 B.U and weakening of dough after 12 min found to be 50 B.U.

Orange pulp :

The same results presented in Table (4) showed the effect of addition of orange pulp to wheat flour 72% extraction on farinograph reading.

From these results, it could be noticed that of orange pulp to wheat flour increase in water absorption of the dough . It was increased from 58.7 to 62.8 for wheat flour with addition of 2.5% of orange peels.

The results indicated also that addition of orange peels to wheat flour caused an increase of arrived time, dough development time and decreased in dough stability. Arrived time was found to be 2 min, dough development time was found to be 3 min, dough stability was found to be 40 B.U, and weakening of dough after 12 min found to be 50 B.U.

Pomegranate peels:

Moreover, the results presented in Table (4) indicated the effect of addition of pomegranate peels to wheat flour 72% extraction on farinograph reading.

From these results, it could be noticed that of pomegranate peels to wheat flour increase in water absorption of the dough. . It was increased from 58.7 to 60.5for wheat flour with addition of 2.5 of pomegranate peels.

Table (4): Farinograph parameter for Dough flour prepared Flour containing 2.5% to tomato peels, orange pulp, pomegranate peels and guava waste.

Blend (g)	Water absorption%	Arrive. time (min)	Dough development time (min)	Dough stability (B.U)	Weakening of dough (B.U)
Wheat flour 72%	58.7	1.5	2	90	100
Wheat flour with 2.5% tomato peels	62.8	1.5	2	70	50
Wheat flour with2.5% orange pulp	62.8	2	3	40	50
Wheat flour with 2.5%pp	60.5	1.5	2	80	50
Wheat flour with 2.5%guava waste	60.2	1.5	2	90	60

Data in table (4), showed that farinograph parameter for dough flour prepared flour containing 2.5% to tomato peels, orange pulp, pomegranate peels and guava waste.

The results indicated also that addition of pomegranate peels to wheat flour caused a decreased in dough stability, dough stability was found to be 80 B.U, and weakening of dough after 12 min found to be 50 B.U.

Guava Waste

The result presented Table (4) indicated the effect of addition of guava waste to wheat flour 72% extraction on farinograph reading.

From these results, it could be noticed that of guava waste to wheat flour increase in water absorption of the dough. It was increased from 58.7 to 60.2 for wheat flour with addition of 2.5 % of guava waste.

The results indicated also that addition of guava waste to wheat flour caused a decreased in weakening of dough, weakening of dough after 12 min, found to be 60 B.U.

The best farinograph parameter for dough prepared flour containing 2.5% of pomegranate peels and guava waste compared wheat flour (control).

- Effect of fortified of macaroni with tomato peels, orange pulp, pomegranate peels and guava waste on chemical composition:

Carbohydrates, protein lipids, fiber and ash were determined in control macaroni (100%wheat flour) and the macaroni which supplementation with different levels of tomato peels, orange pulp, pomegranate peels and guava waste.

The obtained results are shown in Table (5). Regarding the changes in fiber and ash of macaroni under investigation. The macaroni which supplemented with pomegranate peels was height content of protein, fiber and ash as compared to control.

Form the same table's data, it could be noticed that supplementation of macaroni with orange pulp, guava waste was associated with the low increase of protein and fat than that of macaroni without supplementation. These increase in protein, lipids, fiber and ash may due to increase these nutrients in pomegranate peels followed by tomato peels, orange pulp and guava waste. the best results was macaroni with 2.5% pomegranate peels and macaroni with 2.5% guava waste.

Effect of tomato peels, guava waste, pomegranate peels and orange pulp on cooking quality of macaroni:

Cooking properties of the produced macaroni are presented in Table (6). Properties included the percentage of volume increasing, percentage of weight increasing and total soluble solids percentage in cooking water (cooking loss).

From these results it could be noticed the cooking quality of macaroni produced from wheat flour 72% extraction and macaroni with tomato peels, macaroni with guava waste, macaroni with pomegranate peels and macaroni with orange pulp.

Table (5): Chemical composition supplemented of macaroni with 2.5, 5 and 7.5% tomato peels, orange pulp, pomegranate peels (pp) and guava waste.

Parameter macaroni	Protein %	Fat%	Fiber%	Ash%	Total carbohydrates%
Control	8.2	1.3	2.5	0.364	87.64
Macaroni with2.5%tomato peels	8.23	1.41	3.32	0.46	86.58
Macaroni with2.5% orange pulp	8.45	1.45	3.10	0.52	86.48
Macaroni with 2.5%pp	8.61	1.32	3.5	0.954	85.61
Macaroni with 2.5%guava waste	8.31	1.51	2.76	0.37	87.05

pp: pomegranate peels.

Table (6): Cooking quality properties for macaroni with 2.5% of tomato peels, guava waste, pomegranate peels and orange pulp.

Blend	Percentage of weight increase %	Percentage of volume increase %	Cooking loss % (T.S.S)
Wheat flour72%	129	200	9%
Macaroni with tomato peels	164	223	7.2%
Macaroni with guava waste	170	203	7.7%
Macaroni with pomegranate peels	156	188	6.9%
Macaroni with orange pulp	165	215	10.2%

From the results in table (6), it could noticed that showed the percentage of weight increasing in all macaroni with additives were higher than macaroni without additives (129%), which were 164%, 170%, 156% and 165%, respectively.

In the connection of tabulated results indicated that addition 2.5% of tomato peels, guava waste and orange pulp due to significant increase in macaroni volume after cooked as compared to macaroni without additive, it were being 223%, 203% and 215% respectively. While macaroni with pomegranate peels occurred decreased in volume as compared to macaroni without additives, it was recorded 188%.

On other hand, data found that significant decrease in cooking loss by add2.5% of tomato peels, guava waste, and pomegranate peels in macaroni product as compared to macaroni without additives, which it were 7.2, 7.7 and 6.9 %, respectively. While macaroni with orange pulp due to increase in cooking loss amount as compared to macaroni without additives, it was found to be 10.2%.

Conclusion

In this study, data concluded that guava waste, tomato peels, pomegranate peels and orange pulp dietary fiber, used as a dietary fiber and protein sources when produced macaroni supplementation with different additives, It is suggested that the guava seeds, tomato peel and pomegranate peel were good sources of dietary fiber. This dietary fiber may use as food additive as another macaroni products . These products were rich in protein, fiber and ash .

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دراسة كيميائية و تكنولوجية على المكرونة المدعمة بالبروتين والألياف كناتج ثانوى

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الملخص العربي

يهدف هذا البحث إلى إمكانية استخدام بعض المخلفات المصانع مثل قشور الطماطم, مخلفات الجوافة, قشور الرمان وقشور البرتقال كمصدر للألياف. وقد استخدمت الألياف الكلية من قشور الطماطم, مخلفات الجوافة, قشور الرمان وقشور البرتقال لإعداد مكرونة مدعمة بألياف وبروتين بنسبة ٢,٥ ، ٥ ، ٧,٥% من المخلفات. وقد أوضحت النتائج احتواء قشور الرمان على نسبة عالية فى البروتين، الألياف والرماد. أفضل الخصائص الحسية للمكرونة كانت ٢,٥، ٥ ، ٧,٥% للمخلفات الجوافة ، ٢,٥ ، ٥% للقشور الطماطم، ٢,٥% لقشور الرمان و٢,٥ ، ٥% لقشور البرتقال.

الانخفاض فى مرونة العجين لمخلفات الجوافة، قشور البرتقال، قشور الرمان وقشور الطماطم سجلتا أقل انخفاض بينما سجل أعلى مقاومة للشد لمخلفات الجوافة، قشور البرتقال، قشور الرمان وقشور الطماطم بزيادة التركيز من القشور. الخصائص الريولوجية للدقيق الأبيض استخراج ٧٢% المستخدم لإعداد المكرونة، إضافة التركيزات من مخلفات العالية الألياف أدى إلى زيادة فى زمن الوصول ونسبة الامتصاص فى الماء بينما حدث انخفاض فى تطور العجينة ودرجة الأضعاف. اختبارات طهى المكرونة ٢,٥% من (مخلفات الجوافة، قشور البرتقال، قشور الرمان وقشور الطماطم) أوضحت زيادة فى كلا من النسبة المئوية للزيادة فى الحجم والوزن ما عدا المكرونة المدعمة بقشور الرومان حيث سجلت انخفاض فى النسبة المئوية للحجم. تدعيم المكرونة بقشور الرومان وقشور البرتقال كانت مرتبطة بزيادة فى البروتين، الألياف والرماد والذى يرجع إلى وجود العناصر الغذائية.

الكلمات الكاشفة:

مخلفات الفواكه والخضروات – مخلفات الجوافة – قشور البرتقال – قشور الرمان – قشور الطماطم – الخصائص الريولوجية – اختبارات الطهى.