Zagazig J. Agric. Res., Vol. 35 No .(3) 2008 571-591

CHARACTERIZATION OF FIBER PECTIN PREPARED FROM TOMATO PROCESSING WASTES AND ITS UTILIZATION IN LOW-FAT BEEF BURGER

Namir Al-Deen, M., K. El-Sahy, H. Siliha, and F. Badr

Department of Food Science, Faculty of Agriculture, Zagazig University, Egypt.

Accepted 27 /5/2008

ABSTRACT: The use of tomato processing wastes in food formulations can aid in reducing production costs and environmental abuse. The objective of the present study is to chemically and physically characterized the fiber pectin resulted from hot break tomato processing wastes and utilize it in manufacturing of low fat beef burger. The obtained results showed that the yield of tomato fiber pectin was high (83.56%). Tomato fiber pectin had high protein, fat and carbohydrate contents (32.26%, 17.13% and 47.03%, respectively), meanwhile ash content was 2.45%. The highest essential amino acid in tomato fiber pectin was leucine (1.46 g/100g protein) and the highest nonessential amino acid was glutamic acid (6.12 g/100g protein). Essential Fatty acids represent 58.44%of total fatty acids; linoleic (Omega-6) is the most abundant (55.85% of total fatty acids). Tomato fiber pectin with particle size 0.5mm had swelling (4.5 ml/g), water holding capacity (3.57 ml/g) and oil holding capacity (2.65 ml/g). Tomato fiber pectin had high values of Lightness (57.19) and yellowness (34.64), Redness value was low (9.1). Beef burger formulated with different fat replacement level of fiber pectin was studied. Results showed that there were no significant differences in moisture, protein and ash contents among control samples and beef burgers with fiber pectin. The cooking loss and the reduction in diameter of beef burgers decreased by the addition of fiber pectin. The control sample and samples with fat replacement levels of 12.5 and 25% of fiber pectin (2.5 and 5% fiber pectin addition) had the highest acceptability; meanwhile fat replacement with higher levels of 37.5 and 50% (7.5% and 10% fiber pectin addition) were not acceptable to the panelist. These results recommended to use fiber pectin as fat replacer at replacement levels of 12.5 and 25%in low-fat beef burgers manufacture.

Key words: Tomato processing wastes, fiber pectin, low-fat, beef burger.

INTRODUCTION

Tomato (*Lycopersicon eculentum*) being one of the most popular vegetable, is widely grown in the world because of its taste, color, flavor, and nutrient contents. Due to its multiple uses in the preparation of a wide range of products such as juice, ketchup, concentrate, paste, puree, sauces, salsa, soaps, canned whole peeled tomato, and diced tomato. The world production of tomato is estimated by 125.5 million tons. The Egyptian production of tomato fruit reached 7.6 million tons (FAO, 2006).

Approximately 70-80% of the total annual tomato crop is used in the tomato processing industry. The solid wastes, remaining after the juice/pulp extraction process form 40% of the raw material, consisting of skin, seeds, fibrous matter, trimmings, cores, cull tomato and unprocessed green tomatoes picked by harvest machinery (Sogi *et al.*, 2005 and Food quality news, 2004). If these wastes remain unutilized, they not only add to the disposal problem but also aggravate environmental pollution. One of the main problem of the food industry in general and tomato processing industry in particular is the management of waste and their conversion into products of higher value.

Dietary fiber is defined as the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with partial fermentation in the large intestine (American Association of Cereal Chemists, 2000). Dietary fiber includes polysaccharides, oligosaccharides, lignin, and associated plant substances. Different types of plants have varying amounts and kinds of fiber, including pectin, gum, mucilage, cellulose, hemicellulose and lignin.

Besides the medical benefits of Dietary fiber for human health (Champ and Guillon, 2000; Reddy, 1982; Schneeman, 1998 and Tarpila *et al.*, 1978), it also provides many functional properties that affect the technological function of foods such as solubility, viscosity and gelation-forming ability, water-holding capacity, oil-holding capacity, and mineral binding capacity.

It has been reported that carbohydrates, protein or fat-based replacers could be used to reduce fat content of meat products (Egbert *et al.*, 1991 and Giese, 1996); Dietary fiber can be used to achieve this aim. There are many trials performed to use fiber as fat replacers to produce low fat high fiber meat products. Turhan *et al.* (2005) used hazelnut pellicle as a dietary fiber in the production of beef burgers. Results showed that the cooking yield and reduction in diameter and thickness of beef burgers improved by the addition of hazelnut pellicle. Moreover, control samples and 1% and 2% pellicle added samples had high acceptability. Nowak *et al.* (2007) produce low fat german bologna type sausages by using inulin at levels 3, 6, 9 or 12% of the final products' weight. According to the authors, the overall energy content of the sausages produced with citrate and with up to 6% inulin as fat replacer was 22% lower than that of the control sausages.

The objectives of the present study was to chemically and physically evaluate the fiber pectin produced from hot break tomato processing wastes and utilize it as fat replacer in the production of low fat beef burger.

MATERIALS AND METHODS

Materials

Samples preparation

Tomato processing waste samples (Heinz Variety) were collected after the juice extraction process by hot break treatment from Heinz factory 6^{th} of October city- 6^{th} of October Governorate-Egypt. Wastes were dehydrated at 80°C/24 h and kept in disicator until use. The chemicals used in this study were obtained from Al-Nasr and from Al-Algomhuria companies, Egypt.

Methods

Preparation of fiber pectin

Fiber pectin is a sort of alcohol insoluble solids in which pectic substances are released from the cell wall by acid hydrolysis, and precipitated in the presence of alcohol. Thus, pectin is in soluble form and the other cell wall component such as cellulose and hemicellulose are also present in the preparation, therefore it differs from commercial pectin which is a pure pectin. Fiber pectin was prepared According to the method outlined by Siliha (1993). After extraction process fiber pectin was dried at 50°C overnight, and re-weighed again to determine the percentage of fiber pectin, it found to be 83.56%. Then fiber pectin was milled and sieved for getting particles with a diameter of 0.5mm. The fiber pectin powder was stored at 5 °C until further analysis.

Chemical Analysis of Fiber Pectin

Proximate composition was carried out in triplicates on dried ground samples.

- Moisture content, ash, crude fiber, fat, protein, pH value and titratable acidity were measured according to the method of A.O.A.C. (2000).
- Minerals such as Ca^{++}, K^{+}, Na^{+} and Mg^{++} were determined according to the method of Nation and Robinson, (1971) by using the atomic absorption (Varian-spectr AA 220). Results were expressed as mg/100g.
- Total carbohydrates were estimated by difference = 100-(moisture + crude oil + crude protein + ash + titratable acidity)

Determination of Fatty Acid Composition

Oil extraction

The fiber pectin was soaked in pure n-hexane for 24 h to extract the oil content then miscella was filtered using filter paper. The solvent was evaporated using a rotary evaporator at 45°C under vacuum, and the remaining material stored at 5°C in dark brown bottles until used for analysis.

Fractionation and Determination of Fatty Acid

Fractionation and determination of fatty acids was carried by Gas Liquid Chromatography (Pye-Unicam PRO-GC) according to the methods reported by Zygadio *et al.* (1994).

Determination of Amino Acid Composition

Amino acid composition was determined according to Spackman *et al.* (1958) using Eppendrof-Germany LC3000. Amino acid analyzer.

Separation of amino acids was performed at flow rate 0.2 ml/min, pressure of buffer 50 bar and Pressure of reagent 130 bar at temperature of 123°C.

Physical Properties of Fiber Pectin

The color was measured using the Hunter Lab, L optical sensor D25 (Reston, Virginia, U.S.A).Color parameter L* indicates degree of lightness, a* indicates degree of redness to greeness, and b* indicates degree of yellowness to blueness (Hunter, 1958).

Swelling capacity was measured by the bed volume technique (Kuniak and Marchessault 1972) and results were expressed as ml of swollen sample/g of dry initial Sample.

Water holding capacity (WHC) was determined according to Borroto *et al.* (1995) by mixing the fiber pectin with distilled water (1/50, w/v) at ambient temperature for 1 h. The WHC was measured after applying a centrifugal force at 2000 rpm for 30 minutes to estimate the amount of water trapped by the fiber, and the result was expressed as ml of water held by 1 g fiber pectin.

Oil holding capacity (OHC) was determined as described in WHC,except commercial corn oil was used instead of distilled water at the ratio of (1:50w/v), and the result was expressed as ml of oil held by 1 g fiber pectin (Collins and Post, 1981 and Childs and Abjian, 1976).

Utilization of Tomato Fiber Pectin in the Production of Low Fat Beef Burgers

Preparation of low fat beef burgers

Table 1 shows Beef burgers formulation with different levels of fiber pectin. Ground beef (moisture 62.60% and fat 9.92%) was purchased from a local market in Zagazig - Sharqia Governorate, Egypt and divided into 9 batches. The 1st batch was used as a control and adjusted to a fat content of 20% by the addition of back-fat (moisture 2.32%, fat 97.68%).

The other batches were supplemented with different levels of fiber pectin (2.5% for 2nd batch; 5% for 3rd batch; 7.5% for 4th batch; 10% for 5th batch) and adjusted to a fat content of 17.5%, 15%, 12.5%and10%, respectively by the addition of back-fat. These ratios represented fat replacement levels of 12.5, 25, 37.5 and 50% with fiber pectin. The beef burgers mixture contained 1.5% salt, 5% onion, 0.5% black pepper and 0.5% red pepper (Table 1). Each batch was mixed in a blender for 10 min, weighed into 50 g portions, and compressed in a formed plate of which the diameter was 10 cm and the thickness was 0.5 cm. The formed beef burgers were then wrapped with polyethylene and held in a freezer at -20°C until analysis.

Evaluation of Low Fat Beef Burgers

Chemical analysis

The moisture, protein, fat, ash, carbohydrate contents and pH value of samples of burger were determined according to the A.O.A.C. (2000).

Table 1. Beef burgers formulation with different levels of fiber pectin

Ingredient * (g)	control	Fat replacement levels (%)			
		12.5%	25%	37.5%	50%
Meat	80.1	80.1	80.1	80.1	80.1
Added fat (97.68%)	12.35	9.35	6.35	3.35	0.35
Salt	1.5	1.5	1.5	1.5	1.5
Onion	5	5	5	5	5
Black pepper	0.5	0.5	0.5	0.5	0.5
Red pepper	0.5	0.5	0.5	0.5	0.5
Fiber pectin	0	2.5	5	7.5	10

* g/100g

Physical Analysis

Color

The color of beef burgers was measured as described in fiber pectin.

Cooking loss

The beef burgers were cooked using an electrical grill (elis.402) at 290° C for a total of 10 min, 6 min one side and 4 min the other side. The weight of three beef burgers per batch was measured at room temperature, before and after cooking to calculate cooking loss. Total cooking losses were calculated as follows:

$$\text{Cooking loss (\%)} = \frac{\text{Fresh sample weight (g)} - \text{cooked sample weight (g)}}{\text{Fresh sample weight (g)}} \times 100$$

Diameter changes

The diameter of three beef burgers per batch was measured at room temperature, before and after cooking to calculate reduction in diameter.

$$\text{Reduction in Diameter (\%)} = \frac{\text{Fresh sample Diameter (cm)} - \text{Cooked sample Diameter (cm)}}{\text{Fresh sample Diameter (cm)}} \times 100$$

Energy Values

Total calorie estimates (K.cal)for uncooked beef burgers were calculated on the basis of a 100 g sample using Atwater values for fat (9 K.cal g-1), protein (4.02 K.cal g-1) and digestible carbohydrate (3.87 K.cal g -1) (Mansour and Khalil,1997).

Sensory Evaluation (Triangle Test)

Sensory evaluation of beef burgers was performed using triangle test (Helm and Trolle, 1946) by presenting three samples from each batch to the panelist, two of these samples are identical, the third is different and the panelist asked to taste the samples and identify the odd sample, then indicate the degree of difference between the duplicate samples and the odd one and which of them is more acceptable. Results were analyzed by collecting the correct answers.

Statistical Analysis

The experimental data were analyzed statistically according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

Chemical Composition of Fiber Pectin

Hot break processing of tomato juice involves heating of tomatoes during chopping and juice extraction to a temperature of 90°C or higher to inactivate the fruits' native enzymes, namely pectin methyl esterase and polygalacturonase. Thus, the pectic substances in the resultant waste are undegraded.

Results showed that the yield of fiber pectin was 83.56% (Table 2). This result is higher than the yield of fiber pectin prepared from dehydrated lime and orange peel 68.59 and 73.63%, respectively (Sulieman, 2000) and also higher than the yield of pure pectin from apple pomace (15-20%) (May, 1990). This is because the resultant fiber pectin not only consists of pectin but also other fiber compounds such as cellulose and hemicellulose and seed components (protein, fat and ash).

The chemical composition of fiber pectin is shown in Table 2. It had a high fat and protein contents (17.13% and 32.26%, respectively), making up 50% of fiber pectin. It had also high carbohydrate content (47.03%). Ash content was 2.45%. Potassium content was the highest followed by Mg^{++} and Ca^{++} whereas Na^{+} was the lowest. The pH value of fiber pectin was 4.44 and the titratable acidity was 1.13% (as anhydrous citric acid).

Amino Acids Composition of Fiber Pectin

Amino acids composition of fiber pectin is shown in Table 3.

Table 2. Chemical composition of tomato fiber pectin (based on dry weight)

Composition		g/100g
Yield		83.56
Fat		17.13
Protein		32.26
Ash		2.45
Carbohydrate		47.03
Minerals*	Ca++	101.03
	K+	369.70
	Na+	30.57
	Mg++	248.4
pH		4.44
Titratable acidity		1.13

* mg/100g

Table 3. Amino acids composition of tomato fiber pectin

Amino acids	Conc (g/100g protein)
EAA *	
Arginine ☺	1.04
Histidine	0.46
Isoleucine	0.96
Leucine	1.46
Lysine	1.04
Methionine	0.12
Phenylalanine	0.98
Threonine	0.81
Valine	1.23
Total	**8.10**
NEAA **	
Alanine	1.07
Aspartic Acid	3.29
Cystine	0.27
Glutamic Acid	6.12
Glycine	1.27
Serine	0.37
Tyrosin	0.71
Total	**13.10**

* Essential amino acid - ** Nonessential amino acid - ☺ Essential only in certain cases (Fürst and Stehle., 2004 and Reeds., 2000).

Fiber pectin had high contents of most of essential and nonessential amino acids. The highest essential amino acid was leucine followed by valine, lysine, arginine, phenylalanine, isoleucine, threonine, Histidine and the lowest value was methionine.

The highest nonessential amino acid content in fiber pectin was Glutamic acid followed by Aspartic Acid, Glycine, Serine, alanine, Tyrosine, and Cystin. The high content of glutamic acid makes tomato fiber pectin a good source for manufacture of flavor enhancers. Tables 3 show that essential amino acids constitute 38.20%, whereas non essential form 61.79% of total amino acids. Orange seed flour essential amino acids constitute 87.65%, whereas non essential form 12.34% of total amino acids (Gafer, 1995). Lemon seeds flour essential amino acids constitute 87.54%, whereas non essential form 12.45% of total amino acids (Mussa, 1990).

Fatty Acids Composition of Fiber Pectin

Table 4 shows that fiber pectin contained six Fatty acids. The ratio between the numbers of saturated and unsaturated fatty acids was 1:2. Saturated fatty acids make up 18.78% of total fatty acids. Palmitic acid was the abundant saturated fatty acid representing 13.56% of total fatty acids. Unsaturated fatty acids make up 81.19% of total fatty acids, essential fatty acids such as linolenic (Omega-3) and linoleic (Omega-6) representing 58.43% of total fatty acids, linoleic (Omega-6) is the most abundant (55.85% of total fatty acids). These Results are in accordance with Ferrao *et al.* 1986 who reported that C18:2 fatty acids predominated in tomato seed oil, followed by C18:1, with Badr *et al.*, 1994 who reported that Oleic acid content in tomato seed oil was 42% and linoleic acid was 44.1%, and with El-Din and El-Kader, 1997 who reported that Linoleic acid was the major fatty acid in tomato seeds and total tomato processing wastes meal oils, followed by oleic acid. The fact that linoleic acid must be included in the diet of man because it is an essential fatty acid, shows that fiber pectin in which linoleic acid is prevailing can be considered valuable source in the preparation of various food products.

Physical Properties of Fiber Pectin

Hydration properties

Among the physical characteristics

of fiber, hydration properties are of paramount importance to explain its behaviour in food products and its physiological implications in human body. Namely induction of colonic fermentation and increase in stool weight (Stephen and Cummings, 1979 and McBurney *et al.*, 1985). The hydration properties may be characterized by two main parameters: the swelling capacity and the water-holding capacity (WHC).

Swelling

The swelling is defined as the volume of a given weight of dry fiber after equilibrium has been achieved in excess solvent. There are significant differences in swelling capacity between the two particle size (0.25 and 0.5mm), thus fiber pectin with particle size 0.5mm had a higher swelling value than particle size 0.25mm (Table 5). Differences in swelling as affected by particle size seem to be a result of the physical structure porosity and crystallinity of the fiber matrix. These results are lower than that reported in lime 37.66 ml/g and orange 21.23 ml/g fiber pectin (Siliha *et al.*, 2000). This is due to the presence of considerable amounts of other components such as protein and fat in tomato fiber pectin as compared to lime and orange fiber pectin.

Water-holding capacity (WHC)

The water holding capacity is commonly related to the amount of water in the fiber equilibrated in an environment of known water potential, and absorbed by a capillary suction mechanism. Results given in Table 5 showed that fiber pectin of particle size 0.5mm absorbed higher amount of water than 0.25mm this may be due to that the reduction in particle size decreased the theoretical surface area and made the spaces available for free water in the fiber matrix no longer available. Heller *et al.* (1977) have shown that for certain dietary fibers, a reduction in particle size results in a significant decline in the estimated hemicellulose content, a Constituent largely responsible for hydrophilic characteristics and consequently water-holding capacity. Similarly the coarse particles of watermelon fiber pectin had higher water retention (7.20 g water/g), than that obtained with fine particles (5.80 g water/g) (Laban, 2001). It could be noticed that fiber pectin of tomato processing waste had lower (WHC) value compared with lime 17.77 ml/g and orange 13.4 ml/g fiber pectin (Siliha *et al.* 2000).

Table 4. Fatty acids composition of tomato fiber pectin

Fatty acids	Structure	Conc (%)
Palmitic	16:00	13.56
Stearic	18:00	5.22
Total saturated		**18.78**
Palmitoleic	16:01	0.30
Oleic	18:01	22.46
Linoleic	18:02	55.85
Linolenic	18:03	2.58
Total unsaturated		**81.19**
Saturated : Unsaturated		
(2):(4)		

Table 5. Effect of particle size on some physical properties of Fiber pectin prepared from tomato processing waste

Parameter / Particle size	Swelling (ml/g)	Water holding capacity (ml/g)	Oil holding capacity (ml/g)
0.5mm	4.5 [a]	3.57 [a]	2.65 [a]
0.25mm	3.7 [b]	3.36 [b]	1.79 [b]

Values in the same column with different letters are significantly different (Duncan, $P < 0.05$).

Oil-holding capacity (OHC)

Results given in Table 5 showed that particle sizes 0.5mm retained higher oil content than 0.25mm.The (OHC) of fiber pectin from watermelon was 4.75 g/g for the coarse particles and 2.90g/g for fine particles (Laban, 2001).

Color

Tomato is rich in lycopene, the carotenoid in tomato that is responsible for its deep red color. Lycopene is a strong anti-oxidant that has many health benefits to the body.

Lightness (L), redness (+a) and yellowness (+b) values of fiber pectin are given in Fig 1. Results showed that Fiber pectin had high values of Lightness (57.19) and yellowness (34.64), Redness value was low (9.1). The reduction of red color of fiber pectin is due to the removal of lycopene by the organic solvents used during preparation of fiber pectin. Only a fraction of carotenoids which had yellow color was retained in the fiber pectin. USDA National Nutrient Database for Standard Reference, (2005) showed that tomato color formed from lycopene 2570, α carotene 101 and β carotene 447 mcg per 100g tomato fruit.

Production of Low-Fat Beef Burger

Some characteristics of low fat beef burger mixtures

The proximate composition, pH and energy values of Beef Burger formulated with different fat replacement levels of fiber pectin are given in Table 6. Data show that protein contents ranged from 20.01% for the control batch to 23.24% for beef burger with fat replacement levels of 50%. Ash contents ranged from 2.30% for the control beef burger to 2.54% for beef burger with fat replacement levels of 50%. These results are in accordance with those obtained by Mansour and Khalil (1997) who studied the characteristics of low fat beef burgers as influenced by addition of various types of wheat fibers. Differences between fat, carbohydrate, pH and energy value of beef burgers with different fat replacement levels were statistically significant (Table 6). Fat content of control beef burger was 20.07% and reduced to 17.57, 15.06, 12.56 and 10.06% are close to the targeted fat values to the control. Generally as the level of fat replacement was increased by fiber pectin the contents of protein.

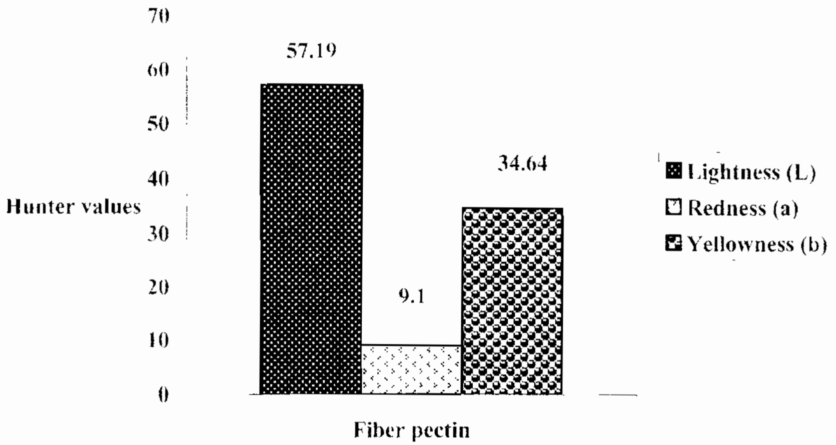

Fig. 1. The hunter lab attributes of tomato fiber pectin

Table 6. Chemical composition and energy value of beef burgers mixtures

	Composition	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)	pH	Energy value (K.cal/100g)
Fat replacement level	Control (0%)	54.99	20.01	20.07 [a]	2.30	2.63 [d]	5.80 [a]	270.89 [a]
	12.5%	54.92	20.82	17.57 [ab]	2.36	4.33 [cd]	5.40 [b]	251.64 [b]
	25%	54.85	21.62	15.06 [bc]	2.42	6.05 [bc]	5.24 [bc]	232.27 [c]
	37.5%	54.78	22.43	12.56 [cd]	2.48	7.75 [ab]	5.09 [cd]	213.02 [d]
	50%	54.72	23.24	10.06 [d]	2.54	9.44 [a]	5.00 [d]	193.78 [e]

Values in the same column with different letters are significantly different (Duncan, $P < 0.05$).

carbohydrate, ash were increased. These changes are due to the fiber pectin added which is rich in protein, ash and carbohydrate. These results are in accordance with those obtained by Garcia *et al.* (2002), Mansour and Khalil (1997) and Turhan, (2005). On the other hand addition of fiber pectin lowered the pH value of the resultant beef burgers. This is due to the low pH value of added fiber pectin (4.44).

Results in Table 6 showed that the control beef burger had the highest energy value. The more fiber pectin was added, the more decrease in energy value was observed. This is due to that the amount of carbohydrate which is mainly consists of fiber pectin was increased, as the level of fat replacement increased.

Quality Characteristics of Low Fat Beef Burgers

Color

The hunter lab attributes of beef burgers formulated with different fat replacement levels of fiber pectin are given in Table 7. It could be noticed that difference in Lightness value was significant, whereas the highest values of lightness was observed in control beef burgers. It could be noticed that the fat replacement with fiber pectin was increased; the values of lightness was decreased. On the other hand there were no significant differences in redness and yellowness values between the control sample and samples with different fat replacement levels with fiber pectin.

Cooking loss

Cooking loss of beef burgers formulated with different fat replacement levels of fiber pectin is shown in Table 8. Results showed that the differences between cooking losses of beef burgers were statistically significant. The control beef burger had the highest cooking loss (56.26%), due to losses which occurred in moisture and fat contents during cooking. The more increase in fiber pectin addition, the more decrease in cooking loss was observed, so the lowest cooking loss value was obtained in beef burgers with fat replacement levels of 50% (10% fiber pectin addition) being 27.88. The decrease in cooking loss caused by addition of fiber pectin can be ascribed in part to the high oil holding capacity and water holding capacity of fiber pectin and to the decrease in animal fat in the low fat beef burgers which would be

Table 7. The hunter lab attributes of beef burgers formulated with different levels of fiber pectin

Hunter values / Fat replacement level	Lightness (L)	Redness (a)	Yellowness (b)
Control (0%)	52.99 [b]	9.64	21.35
12.5%	52.58 [a]	7.91	22.90
25%	49.70 [c]	7.66	23.72
37.5%	49.42 [d]	7.20	25.78
50%	49.27 [d]	6.01	26.25

Values in the same column with different letters are significantly different (Duncan, $P < 0.05$).

Table 8. Cooking loss of beef burgers formulated with different levels of Fiber pectin

Fat replacement level (%)	Cooking loss (%)
0	56.26 [a]
12.5	48.24 [b]
25	41.79 [c]
37.5	35.99 [d]
50	27.88 [e]

Values in the same column with different letters are significantly different (Duncan, $P < 0.05$).

lost during cooking. These results are in agreement with those obtained by Mansour and Khalil (1997), Anderson and Berry (2001),Yilmaz (2003) and Turhan *et al.* (2005) who observed reduction in cooking loss as the amount of fiber was increased in meat products.

Diameter changes of beef burgers

Diameter changes of beef burgers formulated with different of fat replacement levels of fiber pectin shown in Table 9. Differences in diameter between beef burgers were statistically significant. The highest reduction in diameter value was in the control beef burger (36.18%). It could be noticed that as the fiber pectin addition was increased, the reduction in burgers diameter was lowered, thus the lowest values of reduction in diameter were obtained in beef burgers formulated with fat replacement level of 50% (10% fiber pectin addition) being 7.36. These findings are in accordance with Mansour and Khalil (1997), Troy *et al.* (1999), and Turhan *et al.* (2005) who observed that reduction in diameter decreased as the amount of fiber was increased in meat products.

Sensory Evaluation of Low-Fat Beef Burger

There were differences in acceptance between the control sample and beef burgers contained fiber pectin. The more fiber pectin added, the low acceptance of samples was observed. The control sample and samples with fat replacement levels of 12.5 and 25% of fiber pectin (2.5 and 5% fiber pectin addition) had the highest acceptability; meanwhile the acceptability weakened at fat replacement with higher levels of 37.5 (7.5% fiber pectin addition) and 50% (10% fiber pectin addition) were not acceptable to the panelist.

In conclusion, the results presented in this work showed that tomato processing wastes is a rich source of fiber, protein and fat. It also contains high levels of minerals. The utilization of this waste as fiber rich fraction in production of low fat beef burger is highly recommended.

Table 9. Diameter changes of beef burgers formulated with different levels of Fiber pectin

Fat replacement level (%)	Reduction in diameter (%)
0	36.18 [a]
12.5	24.73 [b]
25	23.11 [b]
37.5	19.38 [c]
50	7.36 [d]

Values in the same column with different letters are significantly different (Duncan, $P < 0.05$).

REFERENCES

A.A.C.C. 2000. American Association of Cereal Chemical Approved Methods. The American Association of Cereal Chemists, St. Paul, Minnesota, USA.

A.O.A.C. 2000. Official methods of analysis of association of official analytical chemists.puplished by the A.O.A.C international 17th ED.Washington, D.C.

Anderson, E.T. and B.W. Berry. 2001. Effects of inner pea fiber on fat retention and cooking yield in high fat ground beef. Food Res. Inter., 34, 689-694.

Badr, F., S. Abou El-Maati and S.E. El-Namer. 1994. Evaluation of some agricultural wastes as unconventional sources for oil production. Egypt.Annals of Agric.Sci. Moshtohor., 32 (3):111-117.

Borroto, B., J.A. Larrauri and A. Cribeiro. 1995. Particale size influence on water holding capacity of citrus and pineapple dietary fiber. Alimentaria, No. 268: 89.

Champ, M. and F. Guillon. 2000. Structural and physical properties of dietary fibresearch, and consequences of processing on human physiology. Food Res. Inter., 33, 233-245.

Childs, E. and A. Abjian. 1976. Physio-chemical characterization of peanut hull as potential fiber additive. J. Food Sci., 41: 1235.

Collins, J.L. and A.R. Post. 1981. Peanut Hull Flour as a potential source of dietary fiber. J.Food Sci., 46: 445.

Egbert, W.R., D.L. Huffman, C.M. Chen and D.P. Dylewski. 1991. Development of low-fat ground beef. Food Tech., 45.64-73.

El-Din, M.H.A.S. and M.M.A. El-Kader. 1997. Chemical and biological evaluation of tomato processing wastes. Egyptian J.Food Sci., 25(1): 151-162.

F.A.O. 2006. Food and Agriculture Organization of the United Nations, FAOSTAT database. Web site: http. // www. FAO. Org,2006.

Ferrao, J.E.M., A.M.B.C. Ferrao and M.T.S. Patricio. 1986. Tomato by-products. Fat in tomato seeds and carotenoids in tomato skins.Boletim-Instituto-do-Azeite-e-Productos-Oleaginosos. 13(2): 41-60

Food quality news. 2004. Using tomato waste in food production,web site: http:// www. Food quality news.com. On 2 Mars 2004.

Fürst, P., P. Stehle. 2004. "What are the essential elements needed for the determination of amino acid requirements in humans?". J. Nutr. 134 (6 Suppl): 1558S–1565S. PMID 15173430.

Gafer, A.M. 1995. Chemical and technological studies on preparing edible protein product from citrus seeds. M. Science.Thesis Fac. Agric. Menofiya Univ., Shibin El-Kom, Egypt.

Garcia, M.L., R. Dominguez, M.D. Galvez, C. Casas and M.D. Selgas. 2002. Utilization of cereal and fruit fibers in low fat dry fermented sausages. J. Meat Sci., 60. 227-236.

Giese, J. 1996. Fats, oils and fat replacers. Food Technology, 50, 78-83.

Heller, S.N., J.M. Rivers and L.R. Hackler. 1977. Dietary fiber: The effect of particle size and pH on its measurement. J.Food Sci., 42: 436.

Helm, E. and B. Trolle. 1946. Selection of a taste panel. Wallerstein Lab. Comms. 9:181.

Hunter, R.S. 1958. Photoelectric color difference meter J. Opet Soc.Am., 48 (12) 985-996.

Kuniak, L. and R.H. Marchessault. 1972. Study of cross-linking reaction between epichlohydrin and starch. Die Starke.4: 110.

Laban, M.M.S. 2001. Chemical and biological studies on dietary fibers. Ph. D. Thesis. Food Tech., Fac. of Agriculture., Zagazig Univ., Egypt.

Mansour, E.H. and A.H. Khalil.

1997. Characteristics of low-fatbeefburger as influenced by various types of wheat fibers. Food Res. Inter., 30, 199-205.

May, D. 1990. Industrial pectin, source, production and applications. Carbohydr. Polym. 12:79.

McBurney. M.I., P.J. Horvath, J.L. Jeraci and P.J. Van Soest. 1985. Effect of IN vitro fermentation using human faecal inoculum on the water-holding capacit) of dietary fiber.British J. Nutr., 53, 17-24.

Moussa, S.H.M. 1990. Utilization of some agricultural wastes, Ph.D.Thesis., Fac. Of Agriculture. Menufia Univ.. Egypt.

Nation, J.L. and F.A. Robinson. 1971. Concentration of some majournalor and trace elements in honey bee, royal journalelly and pollen, determined by atomic absorption spectrophotometer. J.Apic.Res., 10 (1): 35-43.

Nowak, B., T. Von Mueffing, J. Grotheer, G. Klein and B.M. Watkinson. 2007. Energy content, sensory properties and microbiological shelf life of german bologna type sausages produced with citrate or phosphate and with inulin as fat replacer. J.Food Sci., 72(9) 629-638

Reddy, B.S. 1982. Dietary fiber and colon carcinogenesis. In G. V. Vahouny, & D. Kritchevsky (Eds.), A critical review: dietary fiber in health and disease (pp. 265-285). New York: Plenum Presearchs.

Reeds, P.J. 2000. "Dispensable and indispensable amino acids for humans". J. Nutr. 130 (7): 1835S–40S. PMID 10867060.

Schneeman, B.O. 1998. Dietary fiber and gastrointestinal function. Nutr Res, 18, 625-632.

Siliha, H. 1993. Effect of method of extraction and raw material on the quality of lime pectin. Alex. Sci.Exch. (14) 539.

Siliha, H., K. El-Sahy, A. Sulieman, R. Carle and A. El-Badawi. 2000. Citrus wastes: composition, Functional properties and utilization. Obst - Gemuese und Kartoffelverarbeitung, 85 (1)31 -36.

Snedecor, G.W. and W.G. Cochran. 1981. Statistical methods 7[Th] Ed.Iowa state univ, presearchs. Ames, Iowa, U.S.A.

Sogi, D.S., R. Bhatia, S.K. Garg and A.S. Bawa. 2005. Biological evaluation of tomato waste seed meals and protein concentrate. Food Chem., 89 (2005) 53-56.

Spackman, D.H., W.H. Stein and S. Moore. 1958. Automtic Recording Apparatus for Use in Chromatography of Amino Acids. Anal. Chem, 30:1190-1206.

Stephen, A.M. and J.H. Cummings. 1979. Water-holding by dietary fiber in vitro and its relationship to faecal output in man. Cut, 20,722-729.

Sulieman, A. M.A. 2000. Studies on food wastes. Ph. D. Thesis. Food Tech., Fac. of Agriculture. Zagazig Univ., Egypt.

Tarpila, S., T.A. Miettinen and L. Metsaranta. 1978. Effects of bran on serum cholesterol, fecal mass, fat. bile acids, and neutral sterols and biliary lipids in patients with diverticular disease in the colon. Gut. 19, 137-145.

Troy, D. J., E.M. Desmond and D.J. Buckley. 1999. Eating quality of low-fat beef burgers containing fat-replacing functional blends. J.Food Sci. Agric., 79, 507-516.

Turhan, S., I. Sagir and N.S. Ustun. 2005. Utilization of hazelnut pellicle in low-fat beef burgers. J.Meat.Sci., 71(2): 312-316.

USDA National Nutrient Database for Standard Reference. 2005. Web site: http:// www. philippineherbalmedicine.org/tomato.htm.

Yilmaz, I. 2003. Effects of rye bran addition on fatty acid composition and quality characteristics of low-fat meatballs. J.Meat.Sci., 67, 245-249.

Zygadio, J.A., R.E. Morero., R.E. Abburra and C.A. Guzman. 1994. Fatty acid composition in seeds oil of some onagraceae. J.Am. Oil Chem. Soc., 71: 915-916.

مواصفات بكتين الألياف المحضر من مخلفات تصنيع الطماطم واستخدامه فى صناعة البيف برجر المنخفض الدهن

محمد نمير الدين محمد النمر – كمال محفوظ الصاحى
حســـن على إبراهيم صليحه – فـــــريد حســـن بـــدر

قسم علوم الأغذية – كلية الزراعة – جامعة الزقازيق

يؤدى استخدام مخلفات تصنيع الطماطم فى مخاليط الغذاء إلى خفض تكاليف الإنتاج والحد من المخاطرالبيئية. تهدف الدراسة الحالية الى دراسة المواصفات الكيماوية والطبيعية لبكتين الألياف االمحضر من مخلفات تصنيع الطماطم الناتجة عن استخدام طريقة الكسر على الساخن واستخدامه فى تصنيع بيف برجر منخفض الدهن وتقييم الخواص الكيماوية والطبيعية والحسية له مقارنة بالمنتجات التقليدية. أظهرت النتائج المتحصل عليها ارتفاع الإنتاجية من بكتين الألياف (٨٣,٥٦%) وقد احتوى على نسبة عالية من البروتين والدهن (٣٢,٢٦% و ١٧,١٣%، على الترتيب). و كان محتوى الرماد ٢,٤٥% حيث ارتفعت فيه نسبة البوتاسيوم و أنخفضت نسبة الصوديوم.و قد كان الليوسين الحمض الأمينى الأساسي الأعلى تركيزاً (١,٤٦جرام /١٠٠جرام بروتين). فيما مثلت الأحماض الدهنية الأساسية ٥٨,٤٤% من مجمل الأحماض الدهنية وكان اللينوليك (أو ميجا ٦) هو الحامض الدهنى الاساسى السائد (٥٥,٨٥%). و بدراسة الخواص الطبيعية وجد ان كثافة بكتين الألياف عند حجم حبيبات ٠,٥ مم (٠,٦٥جم/مل)، سعة الانتفاخ (٤,٥ مل/جم) قدرة ربط الماء(٣,٥٧مل /جم) وقدرة ربط الزيت (٢,٦٥مل/جم). وتمت دراسة تصنيع البيف برجر باستخدام نسب مختلفة من الدهن وبكتين الألياف حيث أوضحت النتائج أنه لا يوجد فرق معنوى فى محتوى الرطوبة، البروتين والرماد بين العينة الكنترول والبيف برجر المضاف إليه بكتين الالياف. انخفض الفقد فى الطبخ وانكماش قطر البيف برجر بزيادة نسبة بكتين الالياف المضاف. وقد أوضح التقييم الحسى ان العينة الكنترول والعينات ذات مستويات استبدال من الدهن ١٢,٥ و ٢٥% ببكتين الالياف أنها كانت الأعلى فى القابلية العامة للاستهلاك بينما العينات ذات نسب استبدال الدهن العالية(٣٧,٥ و ٥٠%) فلم تكن مقبولة على الإطلاق من قبل المستهلك. توصى نتائج هذا البحث بإمكانية استخدام بكتين الألياف كبديل للدهن بنسب استبدال ١٢,٥ و ٢٥% للاستخدام فى صناعة البيف برجر المنخفض الدهن.