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ORIGINAL ARTICLE

Suggested treatments for processing high nutritive value chicken burger

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Abstract The aim of the investigation is to utilize some plant wastes such as (pea hulls, tomato peels, and wheat germ) and other plant materials such as carrot and rusk as untraditional alternatives for making chicken burger in cheaper form (i.e. for minimizing production costs) which could be exported to poorer regions especially in Africa. Proximate composition of raw materials and burgers, amino acids profile and cooking measurements were carried out. Protein content in (G.B: germ burger) treatment had higher protein content (68.56%) owing to the higher protein content of wheat germ (28.62%). Fat content ranged in all treatments between 11% and 19%. Ash content ranged between 2% and 6% owing to different used raw. Leucine is the predominant essential amino acid in all treatments, it ranged between 8.67% (CA.B: collected burger) and 10.34% (T.B: tomato burger), while glutamic acid is the highest non-essential amino acid in all suggested treatments (except T.B treatment) with the percentage of 11.50–13.84%. Various suggested additives minimized cooking loss% with about two folds.

Introduction

Chicken meat is the most popular meat protein source. It may be possibly because of no cultural or religious constraints to the consumption of poultry. Increase in chicken meat popularity has been noted by the fact that it can be processed into ready-to-eat meals (Barbut, 2002). Most of European countries regulated that burgers should contain at least 80% meat and 20–30% fat. In other circumstances, burgers are also recognized as patties Al-Mrazeeq et al. (2008). Unlike most other meats, chicken meat can also easily be enriched with several other important nutrients. In Canada, values of 2–5% have been reported for beef and as high as 8% for lamb. The World Cancer Research Fund and others have suggested that consumption of large amounts (more than 500 g/week) of red meat, particularly processed meat, but not chicken meat, maybe unhealthy (Bingham, 2006). Showed that EU integrated project is providing the scientific basis for better understanding of the health impact dietary fiber and other bio-active components

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of whole grains and for a new generation of healthy products, with high levels of cereal based fibers and bio-active compounds such as vitamins, minerals, antioxidants and other photochemical. Eating more tomatoes and tomato products can make people healthier and decrease the risk of conditions such as cancer, osteoporosis and cardiovascular disease. The study aims to utilize some plant wastes (pea hulls, tomato peel, and wheat germ) as well as carrot and rusk as nontraditional alternatives for processing of chicken burger in cheaper form (i.e. for minimizing production costs) which could be exported to poorer regions especially in Africa.

Materials and methods

Materials

Chicken meat, onion, carrot, salt and spices and rusk were bought from local market. Tomato peels and pea hulls were got from Fodina Company as waste products. Wheat germ was bought from North Cairo Mills Company, Cairo, Egypt.

Preparation of chicken burger

Fresh chicken burger samples were prepared as follows ingredients in (Table 1) which were minced twice, chicken mixture was shaped manually using patty maker to obtain round disks 10 cm diameter and 0.5 cm thickness. Burgers were packed in polyethylene bags in foam dish. The ingredients mixed using mincer then divided into 8 equal portions.

Treatments: Table 2 showed suggested treatments of chicken burger and their abbreviations.

Methods of analysis

Fresh chicken meat was analyzed immediately upon receipt at the laboratory for chemical analysis. The chicken burger was evaluated chemically and physically and organolyptically. Moisture, fiber, protein, fat and ash contents were determined according to the methods described by A.O.A.C. (2000). Total carbohydrates were calculated by difference.

Table 1 Basal constituents of chicken burger formula/(1 Kg).

Ingredients	gm
Minced chicken meat	875
Fresh onion	100
Sodium chloride	15
Black pepper	5
Allspice	5

Amino acids pattern of various treatments was obtained using automatic amino acids analyzer (AAA400), is INGOS Ltd available at Central lab, Cairo University, Giza, Egypt according to Block et al. (1952).

Cooking loss% was calculated as described by A.O.A.C. (2000). After grilling on hot plate with little sunflower oil at 110 °C for 4 min.

$$\%\text{cooking loss} = \frac{\text{fresh burger weight} - \text{cooked burger weight}}{\text{Fresh burger weight}} \times 100$$

Shrinkage percent

Shrinkage percentage was calculated as described by A.O.A.C (2000) as follows:

$$\text{Shrinkage }\% = (a - b) + (c - d) \times 100$$

a is the thickness of uncooked burger, c is the diameter of uncooked burger, b is the thickness of grilled burger and d is the diameter of grilled burger.

Statistical analysis: Data were statistically analyzed according to (SAS, 2006).

Results and discussion

Proximate chemical composition

Proximate composition of raw material (on dry basis) used for making various chicken burger was recorded in Table 3. The data of moisture content were recorded 75.4 of chicken meat, 10.10 of peas, 8.67 of tomato, 13.37 of wheat germs, 10.44 of rusk, 88.20 carrot and 90.34 onion.

The variance between data was return to the difference between the types of material, Bayomey et al. (2007) mentioned that moisture content of pea hulls was 10.03%, and Rubatsky et al. (1999) found that carrot has 88% water.

Protein content showed differentiation between all types of raw material used in experimental burgers according to the type of materials. Data in Table 3 recorded 62 (chicken), 12.1 (peas), 18.36 (tomato), 28.62 (germ), 10.77% (rusk), 4.08 (carrot) and 1.88 (onion). These results agree with Brandolini and Hidalgo (2012) who found that germ contains about 26-35% proteins, while Bayomey et al. (2007) reported that pea hulls contains about 10.10% protein.

Fat content was 12.66 (chicken), 0.6 (peas), 1.3 (tomato), 14.5 (germs), 0.95 (rusk), 0.19 (carrot), and 0.72 (onion). Germ contains the highest content of fat than other materials. The

Table 2 Suggested treatments of chicken burger.

Treatments no.	Ingredients	Abb.
1	Basal formula Table 1 without any additional ingredients (Control)	Control Burger (CB)
2	Basal formula + pea hull 100 g	Pea Burger (P.B)
3	Basal formula + tomato's halls 100 g	Tomato Burger (T.B)
4	Basal formula + wheat germ 100 g	Germ Burger (G.B)
5	Basal formula + rusk 250 g	Rusk Burger (R.B)
6	Basal formula + carrot 25 g	Carrot Burger (Ca.B)
7	Basal formula + carrot 25 g + tomato's hulls 25 g + pea's hulls 25 g + wheat germ 25 g + rusk 25 g	Collected burger (CA.B)

Table 3 Proximate composition of raw material% (on dry basis) used for making various chicken burger treatments.

Raw material	Item					
	Moisture	Protein	Fat	Ash	Fiber	Carbohydrates
Chicken	75.40^{C}	62.00^{A}	12.66^{B}	6.15^{B}	1.95^{E}	17.24^{D}
Peas	10.10^{E}	12.10^{D}	0.60^{C}	5.82^{B}	25.26^{B}	55.22^{BC}
Tomato	8.67^{F}	18.36^{C}	1.30^{C}	6.03^{B}	2.51^{E}	71.78^{AB}
Germ	13.37^{D}	28.62^{B}	14.50^{A}	5.40^{B}	13.30^{C}	38.18^{CD}
Rusk	10.44^{E}	10.77^{E}	0.95^{C}	3.44^{C}	30.26^{A}	54.58^{BC}
Carrot	88.20^{B}	4.08^{F}	0.19^{C}	14.21^{A}	4.00^{D}	59.67^{BC}
Onion	90.34^{A}	1.88^{G}	0.72^{C}	3.76^{C}	2.50^{E}	90.82^{A}

results agree with Bayomey et al. (2007) who reported that fat in dried pea hull was 0.56%, Rubatsky et al. (1999) mentioned that carrot had 0.2% fat. Brandolini and Hidalgo (2012), found that germ contains about 10–15% lipids.

Ash content recorded 6.15 (chicken), 5.82 (peas), 6.03 (tomato), 5.4 (germs), 3.44 (rusk), 14.21 (carrot) and 3.76 (onion). Carrot contains the highest content of ash. While Bayomey et al. (2007) noticed that pea hull ash content had 5.97%.

Fiber content ranged between 1.95% (chicken) and 30.26% (rusk) Brandolini and Hidalgo (2012) found that germ contains about 1.5–4.5% fiber, and Rubatsky et al. (1999) mentioned that the carrot contained about 3% fiber.

Carbohydrates content was recorded 17.24 (chicken), 55.22 (peas), 71.78 (tomato), 38.18 (germs), 54.58 (rusk), 59.67(carrot) and 90.82 (onion).

Data given in Table 4 indicate proximate composition of different chicken burger treatments. There were significant differences between all types of burger in moisture, protein, fat, ash, fiber and carbohydrate contents according to the type of addition. Moisture content showed that, the highest content found in control sample (62.66%), while the lowest one was in (P.B) treatment (44.32%). The other treatments had a moisture content ranged between 51.58% (G.B) and 59.80% (Ca.B).

Protein content in burger was affected according to addition type of raw material. It could be concluded that (G.B) treatment had higher protein content (68.56%) owing to the higher protein content of wheat germ while T.B had the lowest ratio of protein (29.3%). Data recorded 56.7%, 35.54%, 29.30%, 68.56%, 42.14% and 40.59% for C.B, P.B, T.B, G.B, Ca.B and CA.B respectively.

Fat content is the third concerned parameter. From the same (Table 4) it could be concluded that all treatments had about 8.7–19.17% R.B treatment contains the lowest fat content, while Ca.B treatment had the highest. Data recorded 10.8, 15.15, 17.66, 15.78, 8.7, 19.17 and 16.43 of fat respectively in C.B, P.B, T.B, G.B, R.B, Ca.B and CA.B. The results agree with Ramadhan et al. (2011) which recommend that fat content in processed meat products should not exceed than 30%. Ash content in suggested treatments was ranged between 2% and 6%, this is owing to different raw materials which used in chicken burger which contain different percentages of ash content.

Concerning fiber content, it is of interest to record that R.B treatment came in the first order with 19.3% than the other treatments that came in the second order with values ranged between 5.5% and 9.5%. The lowest fiber content was in T.B treatment (3.4%). Obtained results coincided with chemical composition of raw materials that added in different treatments (Table 3). Ramadhan et al. (2011) mentioned that good source of carbohydrates that can be incorporated in burger is dietary fiber. The usage of dietary fiber in processed meat formulation is especially practiced when concerning the economical, nutritive and technological issues. Some of dietary fibers that have commonly been used are cellulose, oat, wheat, potato, carrot, sugar beet, soy and pea fibers.

Regarding carbohydrates content of various chicken burgers there was a significant difference between all types of burgers such as T.B treatment had the highest content (50.64% on dry basis). Meanwhile, the lowest one was recorded in case of G.B treatment. The P.B and CA.B treatments showed moderate content of carbohydrates (37.24% and 32.85%, respectively). On the other hand, sample contained rusk in its formula had a similar content of carbohydrates to that of control one, the Ca.B sample contained 9.70% carbohydrates and came in the third order.

Amino acids profile

Essential amino acids

Essential amino acids identified in various chicken burger treatments were recorded in Table 5. Leucine is the predominant

Table 4 Proximate composition of different chicken burger treatments% (on dry basis).

Treatments*	Item					
	Moisture	Protein	Fat	Ash	Fiber	Carbohydrates
C.B	62.66^{A}	56.70^{C}	10.80^{E}	4.31^{C}	5.47^{E}	22.72^{E}
P.B	44.32^{E}	35.54^{F}	15.15^{D}	4.27^{C}	7.80^{C}	37.24^{B}
T.B	59.20^{AB}	29.30^{G}	17.66^{B}	2.00^{E}	3.40^{F}	50.64^{A}
G.B	51.85^{D}	68.56^{A}	15.78^{CD}	5.90^{B}	7.03^{D}	2.73^{G}
R.B	55.85^{CB}	42.14^{D}	8.70^{F}	6.30^{A}	19.30^{A}	23.56^{D}
Ca.B	59.80^{A}	57.50^{B}	19.17^{A}	4.13^{C}	9.50^{B}	9.70^{F}
CA.B	52.60^{CD}	40.59^{E}	16.43^{C}	2.53^{D}	7.60^{C}	32.85^{C}

amino acid in all treatments (either control or treated one). It ranged between 8.67% (CA.B sample) to 10.34% (T.B sample). Lysine came in the second order with the percentage ranged between 6.58% (R.B sample) and 8.58% (control sample). The rionine and valine came in the third order with value around 5% except Ca.b and CA.B ranged between 3–79 and 4.82 meanwhile, other identified essential amino acids are less than 3% except isolusin In comparing between all treatments in total identification essential amino acids data showed that the highest ratio of amino acid was recorded in control sample (39.37%), while the lowest one (32.63%) was in Ca.B sample. The decreasing in ratio of essential amino acids referred to the decreasing ratio of chicken protein in different treatments. Also, (G.B), (P.B) and (T.B) burgers had a moderate content of identified essential amino acids. Such content was approximately 36%. The result agrees with Brandolini and Hidalgo (2012). Who found that the main by-product of oil extraction is defatted germ meal, which has high protein content (30–32%), is rich in albumin (34.5% of total protein) and globulin (15.6%), and thus presents a well-balanced amino acid profile.

Non-essential amino acids

The percentages of identified non-essential amino acids in various chicken burger treatments are given in Table 6. Glutamic acid showed higher ratio ranged between 11.50% (C.B) and 13.84% (R.B).

Aspartic acid showed approximately similar trend (except in Ca.B treatment), meanwhile, the lowest identified acid was proline that recorded with trace percentages (> 0.1%). Alanine as well as glycine had a moderate ratio around 7–10%. Other identified amino acids; i.e. histidine, serine and arginine ranged between 2% and 5% affecting by suggested treatments.

The total identified non-essential amino acid% was descendingly ordered as: T.B, R.B, G.B and CA.B treatments with the corresponding percentages 56.31%, 55.9%, 55.65% and 55.39%. The lowest percentage of total non essential amino acids was recorded in Ca.B treatment which goes in parallel with earlier results of essential ones. C.B and P.B samples had approximately the same percentage of non-essential amino. The result agrees with Brandolini and Hidalgo (2012). Who found that the main by-product of oil extraction is defatted germ meal, which has high protein content (30–32%), is rich in albumin (34.5% of total protein) and globulin (15.6%), and thus presents a well-balanced amino acid profile.

Cooking measurements

Cooking loss% and % of shrinkage were recorded in the Table 7 which indicate cooking measurements of different suggested chicken burger treatments. Cooking loss was 36.17% in control C.B sample, meanwhile, the lowest percentage 10.88% in R.B treatment. Other treatments (G.B, Ca.B and CA.B) minimize such loss to be about 13.51% on the other hand, T.B and P.B had 15% and 19% of cooking loss, respectively. It means that most additives are minimized cooking loss% by about 2 folds.

Gujral et al. (2009) found that addition of fiber and non meat protein ingredients may reduce diameter shrinkage and weight loss. Loss of weight occurred during cooking chicken burger mainly due to moisture evaporation and drip of melted fat.

Conclusions: Using some new plant sources for making chicken burger, chemical composition and amino acids profile were improved. Thus we could be recommended using these sources in the future to minimize costs of burger processing and improving the nutritive value.

Table 5 % Essential amino acids identified in various chicken burger treatments.

Treatments	Thr	Lysine	Val	Leu	Phe	Met	Ile	Tyr	Total identified essential amino acids%
C.B	4.71	8.58	5.38	10.29	1.96	2.14	4.11	2.20	39.37
P.B	5.09	7.79	5.84	9.54	0.83	0.97	4.50	1.46	36.02
T.B	4.85	7.35	5.66	10.34	1.18	1.14	4.22	1.25	35.99
G.B	4.55	8.51	5.53	9.62	1.51	1.29	3.70	1.47	36.18
R.B	5	6.58	5.22	9.74	1	1.12	3.88	1.48	34.02
Ca.B	4.85	7.24	3.79	9.45	1.01	0.90	3.65	1.74	32.63
CA.B	5.20	6.81	4.82	8.67	1.00	1.49	4.04	1.64	33.67

Table 6 % Non-essential amino acids identified in various chicken burger treatments.

Treatments	Asp	Ser	Glu	Pro	Gly	His	Arg	Ala	Total identified non-essential amino acids%
C.B	12.62	4.32	11.50	0.21	8.06	5.03	2.38	9.28	53.4
P.B	11.64	4.38	13.67	0.04	7.26	5.12	2.29	9.52	53.92
T.B	12.86	4.98	12.08	0.05	9.17	5.33	2.60	9.24	56.31
G.B	11.50	5.35	11.84	0.07	9.67	4.98	2.29	9.95	55.65
R.B	11.26	5.22	13.84	0.04	8.98	5.39	2.16	9.01	55.9
Ca.B	4.538	5.77	13.51	0.03	9.36	5.11	2.17	9.91	50.398
CA.B	11.27	5.37	13.43	0.02	9.39	4.99	2.07	8.85	55.39

Table 7 Cooking measurements of different chicken burger treatments.

Treatment	Item					
	Weight before cooking (gm)	Weight after cooking (gm)	% Of cooking loss	Diameter before cooking (Cm)	Diameter after cooking (Cm)	% Of shrinkage
C.B	95.10	60.70	36.17	9.70	7.00	27.84
P.B	89.14	71.95	19.28	10.00	9.00	10.00
T.B	84.60	72.30	14.58	9.50	9.00	5.26
G.B	113.15	97.86	13.51	10.00	9.00	10.00
R.B	98.50	87.78	10.88	9.50	9.00	5.26
Ca.B	86.60	74.94	13.46	9.50	9.00	5.26
CA.B	74.72	64.89	13.16	9.50	9.00	5.26

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