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ORIGINAL ARTICLE

Fatty acid profile, antioxidant activity of various suggested chicken burger treatments

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Abstract Poultry meat is economic, quick and easy to prepare and serve and it has a number of desirable nutritive and organoleptic properties. Poultry meat is low in fat in relation to other meats. The aim of study was to use some plant wastes such as pea hulls, tomato peels, and wheat germ as well as carrot and rusk in processing of chicken burger to minimize cost of production and to produce burger with high nutritive value which could be exported to poorer regions especially in Africa. This study included fatty acid pattern (either saturated or unsaturated), antioxidant activity, vitamin content and sensory evaluation. T.B, G.B and CA.B treatments had high contents of total saturated fatty acids, and it was ranged between 30.4% and 32.6%. The oleic acid ($C_{18:1}$) is the predominant fatty acid in all treatments except G.B treatment that contained linoleic acid ($C_{18:2}$) as a predominant fatty acid, Antioxidant activity (mg/100 g) of different chicken burger treatments showed some differentiations between all types of burger, and it was recorded 3.9, 12.3, 10.87, 6.96, 7.391, 6.441 and 11.4 in C.B, P.B, T.B, G.B, R.B, Ca.B and CA.B respectively. Chicken burger contains considerable amount of vitamins such as fat soluble vitamin (A, E and D), water soluble vitamins (C, folic acid, nicotinic acid, B1, B6 and B12). Sensory evaluations of chicken burger were evaluated for texture, appearance, color, taste, odor and overall acceptability. The best treatment was CA.B treatment, owing to its higher mean scores of evaluated parameter that is not less than 8.5 and it was the nearest one to that of control treatment. The other treatments that showed similar findings were G.B and Ca.B treatments.

Introduction

In fact, it has been recently demonstrated that replacement of red meat with chicken is associated with a significant decrease in apolipoprotein band total cholesterol levels in microalbu-

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minuric type 2 diabetic patients (Gross et al., 2002). Poultry meat is low in fat in relation to other meats; it is a good foodstuff for primary reason which concerns its fat content. Healthier lipid formation based on processing strategies is one of the most important current approaches to the development of new functional products. Furthermore, both local and imported chicken burgers had high percentage of added water and hydroxyproline, with respect to the standard, which give clear indication of fraudulence, as these ingredients are used to increase the size and weight of the final products without any regard to the nutritional value (Mariam et al., 2012).

The wheat germ is therefore a unique source of concentrated nutrients, highly valued as food supplement. While, the oil is widely appreciated for its pharmaceutical and nutritional value, the defatted germ meal is a promising source of high-quality vegetable proteins. Better nutrient separation from the kernel and improved fractioning techniques could also provide high-purity molecules with positive health benefits Brandolini and Hidalgo (2012). The researchers found that tomatoes are the biggest source of dietary lycopene; a powerful antioxidant that, unlike nutrients in most fresh fruits and vegetables, has even greater bioavailability after cooking and processing. Tomatoes also contain other protective mechanisms, such as antithrombotic and anti-inflammatory functions. Researchers have additionally found a relationship between eating tomatoes and a lower risk of certain cancers as well as other conditions, including cardiovascular disease, osteoporosis, and ultraviolet light-induced skin damage. Freeman and Reimers (2010) various brands of burgers are available in the market with different prices and qualities. The quality of burger may be varied due to the different raw materials and ingredients used and not forgetting the processing methods complied. Presently, the trend among the consumers to eat low-fat products has been a concern to process meat manufacturers (Weiss et al., 2010). The aim of this investigation was to produce 6 types of chicken burger using different plant sources also, to minimize production costs and to produce burger with high nutritive value which could be exported to poorer regions especially in Africa.

Materials and methods

Materials

Chicken, onion, carrot, salt, pepper and rusk were bought from local market. Tomato peels and pea hullsget from Foodina Company, Ismailia governorate 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, all ingredients (Table 1) were minced twice, and 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.

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

Ingredients	gm
Minced chicken meet	875
Fresh onion	100
Sodium chloride	15
Black pepper	5
All species	5

Suggested treatments of chicken burger under studying are given in Table 2.

Fatty acids composition: Fatty acid composition was determined using GLC technique as given by A.O.C.S. (1985).

Antioxidant activity: The antioxidant activity was determined using the DPPH free radical scavenging method as described by Chan et al. (2009).

Vitamins content: Vitamin content was determined using HPLC analysis according to Romeu-Nadel et al. (2006) for vitamin C, Batifoulier et al. (2005) for vitamin B, Pyka and Sliwiok (2001) for vitamin E and A.

Sensory evaluation: Sensory evaluation was carried out according to the method described by Turhan et al. (2009).

Results and discussion

Fatty acids profile

Data given in Table 3 indicated saturated fatty acids detected in different chicken burger treatments. T.B, G.B and CA.B treatments had higher content of total saturated fatty acid content, and it was ranged between 30.4% and 32.4%. Meanwhile, the low content of saturated fatty acids was found in control treatment (14.7%), Ca.B (15.5%) and R.B (18.1%). Treatments that possessed high levels of saturated fatty acids than control may be returned to the content of fiber added to some treatments. This adsorbs more fats during frying and the oil used. It can be arranged our suggested treatments in content of saturated fatty acids in descending order as follows 32.4%, 32.3%, 30.4%, 23.4%, 18.1%, 15.5% and 14.7% for T.B, G.B, CA.B, P.B, R.B, Ca.B and C.B, respectively.

Data in Table 4 represented unsaturated fatty acids of different investigated chicken burger treatments. Oleic acid ($C_{18:1}$) is the predominant fatty acid in all treatments except G.B treatment that contained 46.94% of linoleic acid ($C_{18:2}$) as a predominant one, while $C_{18:1}$ came in the second order with 27.32%. CA.B and R.B treatments had higher content of $C_{18:1}$ (33.69 and 31.77, respectively) close to that of control treatment. The T.B and G.B treatments came in the second order with 29.17% and 27.32%, respectively. The lowest level of $C_{18:1}$ (8.68%) was detected in Ca.B treatment. Regarding the level of $C_{18:2}$ in different investigated chicken burger treatments, G.B treatment contained higher level of such fatty acid as shown earlier. This is due to the addition of wheat germ that contains higher level of unsaturated fatty acids. A moderate level of $C_{18:2}$ (17–23%) was detected in T.B, R.B, P.B and CA.B treatments, and the lowest level of $C_{18:2}$ (6.42%) was recorded in Ca.B treatment. The $C_{16:1}$ unsaturated fatty acid came in the third order with the values ranged between 3.6% and 5.6% higher than that of control one (1.2%) in various investigated treatments except R.B sample that content (0.63%) lower than control sample. The other detected unsaturated fatty acids; i.e. $C_{17:1}$, $C_{18:3}$ and $C_{20:1}$ came with lower levels. Regarding the total unsaturated fatty acids, (G.B) treatment had 86% followed by CA.B 65% and other treatments

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 Saturated fatty acids identified in various chicken burger treatments.

Treatment	Saturated fatty acid								
	Lauric $c_{12:0}$	Meyristic $c_{14:0}$	Palmitic $c_{16:0}$	Margarins $c_{17:0}$	Behenic $C_{22:0}$	Lignoceric $C_{24:0}$	Stearic $c_{18:0}$	Arachidic $C_{20:0}$	Total saturated fatty acids (%)
C.B	0.03740	0.21952	9.32942	0.08909	0.61730	0.19804	3.87378	0.29437	14.65892
P.B	2.65308	0.67433	14.20426	0.39524	0.28362	0.32280	4.13690	0.70771	23.37794
T.B	1.59235	1.65228	20.67660	0.74539	0.48033	0.77957	5.90102	0.62219	32.44973
G.B	1.17104	1.24788	21.78210	0.36943	0.88306	0.42059	5.33801	1.04942	32.26153
R.B	0.19663	0.18534	13.60666	0.14075	0.27887	0.28795	2.94105	0.46393	18.10118
Ca.B	5.01882	1.22288	5.71207	0.49384	0.24890	0.20864	1.70393	0.84338	15.45246
CA.B	0.55578	0.65760	21.04236	0.20204	0.15988	1.36604	5.75204	0.65005	30.38579

Table 4 Unsaturated fatty acids of different investigated chicken burger treatments.

Treatment[a]	Fatty acid						
	Palmitoleic acid $C_{16:1}$	Heptodecenoic acid $C_{17:1}$	Oleic acid $C_{18:1}$	Linoleic acid $C_{18:2}$	Linoleic acid $C_{18:3}$	Ecosonic $C_{20:1}$	Total unsaturated fatty acids (%)
C.B	1.20	0.06	34.48	8.73	0.42	0.35	45.24
P.B	4.19	1.09	22.53	21.78	2.32	0.73	52.64
T.B	5.62	1.45	29.17	17.35	1.84	0.78	56.21
G.B	5.90	0.11	27.32	46.94	1.32	4.43	86.02
R.B	0.63	0.63	31.77	17.86	2.24	2.59	55.72
Ca.B	3.64	1.64	8.68	6.42	0.90	N.D[b]	21.28
CA.B	4.60	1.14	33.69	22.70	1.42	1.27	64.82

[a] See materials and methods.
[b] N.D. Not detected.

(P.B, T.B and R.B) contained 52–56% higher than that of control one (45%) the Ca.B treatment had the lowest percentage of total unsaturated fatty acid (21.28%). The high level of unsaturated fatty acids in G.B, R.B and CA.B may be returned to the ratio of unsaturated fatty acids in wheat germ and rusk which made from wheat flour. Romans et al. (1994) found that meat lipids usually contain less than 50 saturated fatty acids (SFAs of which only 25–35 have atherogenic properties), and up to 70 (beef 50–52, lamb 50–52, chicken 70, rabbit 62) unsaturated fatty acids (mono unsaturated fatty acid, MUFAs and polyunsaturated fatty acid.

Antioxidant activity

Antioxidant activity of different chicken burger treatments is indicated in Table 5. Some differentiations between all types of burger were recorded. Values were 3.9, 12.3, 10.87, 6.96, 7.391, 6.441 and 11.4 in C.B, P.B, T.B, G.B, R.B, Ca.B and CA.B respectively. P.B treatment showed higher antioxidant activity than other treatments. The data can be arranged in descending order as follows P.B, CA.B, T.B, R.B, G.B,

Table 5 Antioxidant activity (mg/mole) of different chicken burger treatments.

Treatment	Antioxidant activity
C.B	3.90
P.B	12.3
T.B	10.87
G.B	6.96
R.B	7.391
Ca.B	6.441
CA.B	11.40

Table 6 Vitamin content (mg/100 g) of different chicken burger treatments.

Treatment	Vitamin									
	(A)	(E)	(D) IU	(C)	Folic acid	Nicotinic	B 1	B 6	B 12	Total determined vitamins
C.B	0.370	0.01	182.05	8.9	0.08	71.03	2.05	2.28	0.51	267.3
P.B	0.91	0.23	244.52	9.99	2.02	24.07	7.75	5.56	12.05	307.1
T.B	1.09	1.65	183.69	5.35	0.13	10.57	2.14	3.95	3.48	212.05
G.B	0.18	0.16	208.22	8.2	0.55	19.93	0.78	1.08	6.32	245.45
R.B	1.99	0.19	192.25	3.79	0.58	15.2	0.48	0.82	4.72	220.02
Ca.B	1.01	0.15	352.73	3.43	0.41	15.58	2.25	0.6	2.85	379.01
CA.B	12.66	0.58	557.18	6.49	1.47	71.49	3.18	14.99	2.04	670.08

Table 7 Sensory evaluation of different chicken burger treatments.

Treatment	Item					
	Texture /10	Appearance/10	Color/10	Taste/10	Odor/10	Overall acceptability
C.B	9.62	9.80	9.63	10.00	10.00	49.05
P.B	7.00	6.87	6.87	5.62	7.13	33.49
T.B	7.37	8.50	8.25	7.62	8.00	39.74
G.B	8.37	9.00	8.63	8.25	8.25	42.5
R.B	8.87	9.12	8.75	8.50	8.75	43.99
Ca.B	8.87	8.88	8.38	8.25	7.13	41.51
CA.B	7.00	7.25	9.63	6.88	7.13	37.89

Ca.B, and C.B it means that different treatments were increased antioxidant activity.

Vitamins content

Data recorded in Table 6 showed amount of vitamins in different chicken burger treatments. Burger had some vitamins such as fat soluble vitamin A, E and D, as well as water soluble vitamin C folic acid, nicotinic acid, B1, B6 and B12. Chicken burger treatments contain vitamin A in different ratios according to the type of addition. The highest ratio of vitamin A was in CA.B treatment (12.66 mg/100 g). The other treatments recorded 0.37, 0.91, 1.09, 0.18, 1.99 and 1.01 mg/100 g in C.B, P.B, T.B, G.B, R.B and Ca.B treatments respectively. The highest level of vitamin E (1.65 mg/100 g) was in T.B treatment, while, the other treatments recorded 0.01, 0.23, 0.16, 0.19, o.15 and 0.58 respectively in C.B, P.B, G.B, R.B, Ca.B and CA.B treatments.

All treatments contain vitamin D in different units, and the highest one was in CA.B (557.18 Ill). The other treatments recorded 182.05, 244.52, 183.69, 208.22, 192.25, and 352.73Ill in C.B, P.B, T.B, G.B, R.B and Ca.B treatments respectively. Vitamin C was found in moderate amount in all treatments; i.e. 8.9, 9.99, 5.35, 8.2, 3.79, 3.43 and 6.49 mg/100 g respectively in C.B, P.B, T.B, G.B, R.B, Ca.B and CA.B treatments. It could be noticed that P.B, C.B and G.B had a higher ratio of vitamin C than other treatments. Folic acid was recorded 2.02, 0.13, 0.55, 0.58, 0.41 and1.47 mg/100 g in P.B, T.B, G.B, R.B, Ca.B and CA.B treatments respectively. C.B and Ca.B had a lower ratio of folic acid than other treatments. Nicotinic acid was found in highest amount in all treatments, and it was 71.03, 24.07, 10.57, 19.93, 15.2, 15.58 and 71.49 mg/100 g in C.B, P.B, T.B, G.B, R.B, Ca.B and CA.B treatments, respectively. C.B, CA.B, and P.B had a higher ratio of such vitamin. The high level of vitamin B group was in P.B. It is of interest to report that meat and chicken products did not consume as a source of vitamins, but in this investigation such vitamin content gives an indicator about added raw materials used for making chicken burger as a source of vitamins that enriched such chicken product with vitamins.

Sensory evaluation

The suggested treatments of chicken burger were sensory evaluated for texture, appearance, color, taste, odor and overall acceptability. The best one was R.B treatment, owing to its higher mean scores of evaluated parameters 8.5 and it was the nearest one to that of control treatment. The other treatments that showed similar findings were G.B and Ca.B treatments (Table 7).

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