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UTILIZATION OF POULTRIES FEATHERS IN FOOD AND FEED: 5-NUTRITIONAL VALUE AND PHYSICAL PROPERTIES OF BEEFBURGERS PREPARED WITH DIFFERENT LEVELS OF CHICKEN FEATHERS PROTEIN ISOLATE.

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Abstract

Chicken feathers protein isolate (F.P.I.) prepared by KOH hydrolysis and precipitation at isoelectric point by orthophosphoric acid was used to replace 0, 10, 15, 20 and 25% of beef in beefburgers after it was F.P.I. diluted with water at 1:2 ratio. Protein was somewhat increased in fried burgers with increasing of diluted F.P.I. level. Up to 20% F. P. I. no deficiency in essential amino acids (EAA) was observed in fried products , but at 25% F. P. I. level as indicated by amino acid (A.S.) , very slight deficiency (2%) was found for threonine. The decrease in calculated essential amino acid index (EAAI), biological value (B.V.) and protein efficiency ratio (PER) was not noticed as the level of F.P.I. increased in fried burgers. Grams consumed to cover the protein daily requirments of adult man (GDR) decreased, while GDR values for methionine (showed the highest GDR value, for EAA) increased. When consuming 150gm of fried 25 F.P.I. burgers, the protein and methionine daily requirements of adult man will be covered at the levels of 76% and 70%, respectively, whic is quite high (more than one half the daily requirements in one meal). As the percent of F. P. I. increased, water holding capacity (WHC) and cooking yield improved , while cooking loss decreased. Tenderness as indicated from PWFC value (protein- water fat coefficient and plasticity) somewhat decreased. At 25% F. P. I. level, aroma,taste , colour and overall acceptability scores were markedly high (rated very good, 8-9 scores), but due to some decrease in texture (rated good, 7 scores) it is enough to replace 20% of beef with equal proportion of diluted F.P.I.

INTRODUCTION

Beefburger is a patty prepared form chopped of minced beef and other ingredients spices. Meat substitues such as the vegetable protein might be used as reported by Minanni and Kyodo (1973). Some meat substitutes showed a functional role through improvement of the water holding capacity (WHC), besides the improvement of nutritional value due to increase of protein content (Klina, 1975). Baldwin *et al.* (1975) found no difference in flavour between turkey patties propared with and without 10% soy protein. According to Kapsiotis (1978) (Codex Alimentarius commission) FAO/WHO specifications, stipulated no limit of added soy protein as meat substitute in patties including burgers. But vegetable protein (Chinorov *et al* ., 1981), while improved the WHC of patties and protein, it decreased the concentration of lysine and sulfur amino acids when substituted 30% of meat. Cooking loss was also decreased when soy protein concentrate replaced 30% of meat in chicken pattties (Darwiesh, 1986)

A protein isolate (P.I.) was prepared from alkaline hydrolyzate of keratin with animal blood to be used in France in baby food formulas (Dulard and Paivot, 1975), taking into consideration that blood is prohibited in man's diet according to Islamic religion, Darwiesh (1981) prepared a mixtured P.I. of hydrolyzed keratin (buffalo horns and hooves) with animal blood to be used in milk replacers for sucking buffalo calves. Ghoneim *et al.* (1982) used hydrolyzed then dried buffalo horns as meat substitute. This practice did not affect the beef sausage flavour, while increased the WHC and cooking yield without affecting the essential amino acid (EAA) contents of fried products.

This work was conducted to study the effect of using feathers protein isolate F.P.I. at different levels on the nutritional value and physical characteristics of beefburger.

MATERIALS AND METHODS

Protein isolate:

Chicken feathers were washed, dried and cut into small pieces, then soaked 2-

4 days at room temperature in 4% KOH solution. Hydrolysis was then carried out by boiling in the same KOH solution under atmospheric pressure for 6-8 h, followed by cooling , neutralization with 1% orthophosphoric acid (at pH 4.5). After 1-2 hours the liquid was withdrawn and the precipitate was washed with a weak flow of running water for 2-4 h, vacuum dried (500mm) at 100°C to obtain feather protein isolate F.P.I.

F.P.I. was diluted with water at the ratio 1:2 (F.P.I.:water) then used for substitution of 0, 10, 15, 20 and 25% of beef in beefburgers.

Beefburgers

Beefburgers were prepared using the following formula :

Lean beef	67.0%	Salt (Na Cl)	2.0 %
Fat tissues (of beef)	19.5%	Spices mixture	1.5%
Water (as ice flakes)	10.0 %		100
Spices mixture (%)			
Black pepper	5.61	Cardamon	2.24
Cumin	11.21	Cloves	2.24
Cubeb	22.42	Garlic	56.06
Nutmeg	0.22		100

Imported frozen beef was thawed and minced . Fat tissue was also minced. Ingredients were then mixed in a laboratory cutter (Hobart C100 speed No.2) for 10 minutes, followed by shaping burgers of 10cm diameter and 0.5cm thickness, about 60g weight each.

Burgers were weighed before and after frying in vegetable oil for 2minutes at 240°C, the cooking loss was calculated. To evaluate burgers of different treatments, moisture, protein (Nx6.25, Kjeldahl method), fat (hexane solvent , Soxhlet apparatus) ash , fibers, carbohydrates (by difference) and salt were determined using the methods described by the A.O.A.C. (1980) . Before calculating carbohydrates, the actual ash content of samples was obtained by subtracting from the ashing result the corresponding ash of sodium chloride content. Energy value was estimated by multiplying protein and carbohydrates by 4.0 and fat by 9.0 respectively. Amino acid composition was determined after HCl hydrolysis using paper

chromatography method as described by Block (1958) , while tryptophan was determined colorimetrically after alkaline hydrolysis using the method described by Blauth *et al.* (1963).

Assuming that the burgers were the sole source for protein , energy and EAA, grams of products consumed to cover the protein and energy daily requirements for adult man (56 g protein, 2700 Cal., Nat. Acad . Sci., 1980) were calculated (GDR); percent satisfaction of the protein and energy daily requirements for man (PS/150) when consuming 150gm of burgers were also calculated, respectively . This was carried out for comparison between samples, as indicated by amino acids composition (g /100g wet sample). GDR values in each of EAA was calculated using dietary allowances (for adult man) as given by the Nat. Acad. Sci. (1959). Amino acids score (A.S.) were caluculated using FAO reference protein (FAO/WHO, 1973) as follows:

$$\text{A. S.} = \frac{\text{amino acid content (g/16gN) of sample}}{\text{amino acid content (g/16 g N) of the pattern}}$$

Essential amino acid index (EAAI) and biological value (B.V.=1.09 x EAAI - 11.73) were calculated in relation to egg protein using all individual EAA according to Oser (1959). Calculated protein efficiency ratio (PER) of products obtained using amino acids composition (g/16 gN) by 3 equations as described by Alsmeyer *et al.* (1974) as follows:

PER_1 = - 0.684 + 0.456 (Leucine) - 0.047 (Proline).

PER_2 = - 0.468 + 0.454 (Leucine) - 0.105 (Tyrosine).

PER_3 = 1.816 + 0.435 (Methionine) + 0.78 (Leucine).

+ 0.211 (Histidine) - 0.944 (Tyrosine).

WHC (in cm^2 and as % bound water, % of moisture content and plasticity (as indication for tenderness in cm^2 and as cm^2 / 1gm T.N.) were measured by following the method of Soloviev (1966). Texture index, i. e. protein - water fat coefficient (PWFC = $\frac{\text{\% Protein}}{\text{\% water + \% fat}}$) was caicutated accordin to Tsuladze (1972) .

Tenderness increased with decreasing of PWFC and vice versa. Feder value as one of quality attributes of comminuted meat products was dtermined according to the method described by Pearson (1970) .

$$\text{Feder value} = \frac{\text{\% Water}}{\text{\% Organic non fat}}$$; where % organic non fat = 100-(% fat+% ash

+ % moisture) . Values below 4.0 indicate good quality of meat product. Organoleptic evaluation was carried out on Cooked burgers by ten Panel testers according to Molander (1961). Judging scale for colour , aroma , taste, texture and overall acceptability was as follows:

Very good	8-9	Poor	2-3
Goo	6-7	Very poor	0-1
Fair	4-5		

RESULTS AND DISCUSSION

A - Proximate composition of beefburgers

F. P. I. was firstly diluted with water at the ratio of 1:2, then used for substitution of 10, 15, 20 and 50% of beef in beefburgers. Regardless of the dilution with water, F.P. I. (more than 90% protein on dry weight basis) Abd El - Moaty (1989) was able to raise the protein content of beefburgers (Table 1) form about 14% to about 15-16% (WW) when substituting 10-25% of beef. As the F.P.I. level increased , the moisture and fat contents of uncooked burgers decreased, carbohydrates slightly increased. Ash . fibers, salt and every other value however remained almost stable. It seems posible that the water binding ability of F. P. I. was quite effective during cooking . In contrast to raw burgers, the moisture content of fried burgers increased as the level of F. P. I. increased (Table 2).

As a result of the loss in moisture by cooking, other components increased on wet weight basis (WW). Due to the apparent increase in protein , fat and carbohydrates (WW), the energy value increased by frying. Assuming that the burgers are the sole source for protein and energy, the calculation of GDR and P.S. /150 values (for adult man) should give a good indication about the nutritional vlaue of the different the samples. The decrease of GDR and increase of P.S. /150 for protein and energy indicated that the nutritional value of burgers increased by frying as well as with raising the level of F.P.I. in burgers for protein . The consumption of 150g of fried burgers containing 0% (control), 20 and 25% diluted F.P.I. might cover 68% , 75% and 76% of man's daily protein requirements, respectively and 21.02 , 17.75 and 17.11% of the daily energy requirements for man, respectively). There-

Table 1. Chemical composition of uncooked beefburgers as affected by the level of F.P.I.

Samples (levle of F.P.I %)		Mois-ture %	Prot-ein %	Fat %	Ash %	Fibers %	Carb-ohydr ates %	Salt %	Energy value cal/100 gm	G.D.R for prot-ein	G.D.R for protein	P.S/150 for protein	P.S/ 150 for energy
0%	WW	60.29	14.36	21.24	1.69	0.02	1.20	1.98	253.40	390	1066	39	14
	DW	------	36.16	53.49	4.26	0.05	3.02	4.99	---	--	--	--	--
10%	WW	59.92	17.99	20.95	1.69	0.02	1.22	2.00	253.39	374	1066	40	14
	DW	-------	37.40	52.27	4.22	0.05	3.02	4.99	---	--	--	--	--
15%	WW	59.74	15.31	20.80	1.68	0.02	1.24	1.99	253.40	366	1066	41	14
	DW	-------	38.03	51.66	4.17	0.05	3.08	4.94	---	--	--	--	--
20%	WW	59.74	15.62	20.65	1.69	0.02	1.25	2.00	253.33	359	1066	42	14
	DW	-------	38.63	51.06	4.18	0.05	3.09	4.95	---	--	--	--	--
25%	WW	59.37	15.94	20.51	1.68	0.03	1.26	1.99	253.39	351	1066	43	14
	DW	-------	39.23	50.48	4.14	0.07	3.10	4.90	----	--	--	--	--

WW: wet weight basis, DW : Dry weight basis
G.D.R. grams consumed to meet the protein or energy daily requirements for adult man.
P.S. /150 :Percent satisfaction of the protein or energy daily needs for adult man when consuming 150 g of the product.

Table 2. Chemical composition of fried beefburgers as affected by the level of F.P.I.

Samples (levle of F.P.I %)		Mois -ture %	Pro- tein %	Fat %	Ash %	Fibers %	Carb- ohydr ates%	Salt %	Energy value cal/100 gm	G.D.R for prot- ein	G.D.R for protein	P.S/150 for protein	P.S/ 150 for energy
0%	WW	38.34	25.25	29.98	2.63	0.03	1.90	3.08	378.42	222	714	68	21.02
	DW	--	40.95	48.62	4.27	0.05	3.08	5.00	-- 252.72	--	--	--	--
10%	WW	40.80	26.31	26.64	2.50	0.03	1.93	2.95		213	71	71	19.60
	DW	--	44.44	45.00	4.22	0.05	3.26	4.98	--	--	--	--	--
15%	WW	42.11	27.16	24.61	2.41	0.03	1.95	2.86	337.93	206	73	73	18.77
	DW	--	46.92	42.51	4.16	0.05	3.37	4.94	--	--	--	--	--
20%	WW	43.81	27.97	22.19	2.35	0.03	1.69	2.78	319.43	200	75	75	17.75
	DW	--	49.78	39.49	4.18	0.05	3.49	4.95	--	--	--	--	--
25%	WW	44.91	28.45	20.69	2.28	0.04	1.99	2.70	307.97	197	76	76	17.11
	DW	--	51.64	37.56	4.14	0.07	3.61	4.90	--	--	--	--	--

WW: wet weight basis, DW : Dry weight basis
G.D.R. grams consumed to meet the protein or energy daily requirements for adult man.
P.S. /150 :Percent satisfaction of the protein or energy daily needs for adult man when consuming 150 g of the product.

fore,the nutritional value increased due to the incroporation of F.P.I. because beef-burgers are mainly consumed as a protein source . But even if protein was not increased due to such practice, the benefit resulting from using feather in human's diet could decrease production cost and consumer's price if the nutritional value was not affected.

It seem's reasonable that F.P.I. will be much cheaper than the P.I. of soy. This is because defatted soy meal (about 2.5% fat and 50% protein) price is 850 L.E. per ton while the cost of 1 ton chicken feathers (about 1.5% fat and 84% protein) is about 30 L.E. (according to the local price in 1988). Both products are starting raw materials for P.I. processing.

B-Amino acids composition

F.P.I. (KOH - H_3PO_4) was found to be deficient in tryptophan, valine, threonine, lysine and phenylalanine + tyrosine when compared with the FAO reference protein (Abd El-Moaty, 1989). From the results in Table 3 it could be osbserved that calculated EAAI, B.V., and $PER_{1,2,3}$ values showed some decrease as the proportion of F.P.I. increased in fried burgers . But when compared with the FAO pattern, it was readily obvious that up to 20% F.P.I. no deficiency was observed in any of the EAA indicating high nutritional an biological values of 10, 15 and 20% F.P.I. burgers. In this case the EAA of beef protein compensated the deficiency of some EAA of F.P.I. Nevertheless at 25% F.P.I. level, beef protein was unable to compensate the deficiency in threonine only, which was still slightly less (by 2%) when compared with the FAO reference protein (A. S. value for threonine was 98% that of the FAO). From the results of Table 4 it is evident that highest GDR value for individual EAA was recorded for methionine (177-216 g) . This means that when 177 - 216 g of fried products were consumed, methionine daily requirements for adult man (as well as in all other EAA) will be covered. According to P.S /150 values for methionine (decreased with the increase of F. P. I. level), when 150g of fried 25% F.p.I. burgers were consumed, methionine daily requirements for adult man will be met at 70% level , which might be considered as quite high. But according to P.S. values, when GDR value for protein (197g for 25% F. P. I. fried sample), methionine daily requirements for adult man will be covered at 91.82% level; other EAA will be covered at more percentages. When consuming 150 g of fried 20 and 25% F.P.I. burgers, protein and methionine daily requirements of man will be covered at the levels of 75, 72% and 76 , 70%, respectively (Tables 3 and 4). It is evident that more than half the protein and methionine daily requirements of man will be covered when

Table 3. Amino acid composition of fried beefburgers protein as influenced by the level of F.P.I. (g/16g N)

Samples (level of F.P.I.%) / Amino acids	FAO reference protein gm/16 gm N	0%		10%		15%		20%		25%	
		gm/16gm N	A.S.	gm/16gm N	A.S.	gm/16gm N	A.S.	gm/16gm N	A.S.	gm/16gm N	A.S.
Leucine	7.0	8.17	1.17	8.12	1.16	8.09	1.16	8.06	1.15	8.03	1.15
Isoleucine	4.0	5.11	1.28.	5.06	1.27	5.03	1.26	5.01	1.25	5.00	1.25
Phenylalanine		4.45		4.22		4.11		4.01		3.91	
Valine		5.34		5.22	1.04	5.16		5.10		5.04	
Methionine	5.0	2.44	1.07	2.17		2.03	1.03	1.91	1.02	1.79	1.01
Tyrosine		3.81		3.67		3.61		3.55		3.49	
Proline		5.13		5.34		5.43		5.52		5.61	
Alanine+glutamic		23.58		22.13	1.08	21.44		20.79		20.16	
Threonine	4.0	4.62	1.16	4.33		4.19	1.05	4.06	1.02	3.93	0.98
Glycine		6.22		6.49		6.62		6.75		6.87	
Aspartic acid		9.26		8.90		8.73		8.57		8.41	
Serine		4.16		4.61		4.83		5.04		5.23	
Arginine		6.70		6.39		6.25		6.12		5.99	
Histidine		3.00		2.76	1.45	2.65		2.54		2.44	
Lysine	5.5	9.12	1.66	7.99		7.45	1.34	6.94	1.26	6.4	1.17
Cystine		1.33		1.64		1.79		1.93		2.06	
Tryptophan	1.0	1.28	1.28	1.16	1.16	1.11	1.11	1.05	1.05	1.00	1.00
Methionine+cystine	3.54	3.77	1.08	3.81	1.09	3.82	1.09	3.84	1.10	3.85	1.10
Phenylalanine+tyrosine	6.0	8.26	1.38	7.89	1.32	7.72	1.29	7.56	1.26	7.40	1.23
EAAI		86.02		82.14		80.24		78.32		76.48	
B.V.		82.03		77.80		75.73		73.64		71.63	
PER_1		2.80		2.77		2.75		2.73		2.71	
PER_2		2.84		2.83		2.83		2.82		2.81	
PER_3		2.65		2.85		2.53		2.49		2.45	

A.S. : amino acid scores
EAAI : essential amino acid mdex
B.V : biological value
$RER_{1,2,3}$: protein efficiency ratio

Table 4. Amino acid composition of fried beefburgers (g/100g wet sample) as affected by the level of F.P.I.

Samples (levle of F.P.I. %) / Anino acids	Daily requirements of man in gm	0%		10%		15%		20%		25%	
		g/100g sample	G.D.R	g/100g sample	G.D.R	g/100g sample	G.D.R	g/100g sample	G.D.R	g/100g sample	G.D.R
Leucine	1.10	2.06	53	2.14	51	2.20	50	2.25	49	2.29	48
Isoleucine	0.70	1.29	54	1.33	53	1.37	51	1.40	50	1.42	49
Phenylalanine	1.10	1.12	98	1.11	99	1.12	98	1.12	98	1.11	99
Valine	0.80	1.35	59	1.37	58	1.40	57	1.43	56	1.43	56
Methionine	1.10	0.62	177	0.57	193	0.55	200	0.53	208	0.51	216
Tyrosine		0.96		0.97		0.98		0.99		0.99	
Proline		1.30		1.41		1.48		1.54		1.60	
Alanine+glutamic	0.50	5.95	43	5.82	44	5.82	44	5.82	44	5.74	45
Threonine		1.17		1.14		1.14		1.14		1.12	
Glycine		1.57		1.71		1.80		1.89		1.95	
Aspartic acid		2.34		2.34		2.37		2.40		2.39	
Serine		1.05		1.21		1.31		1.41		1.49	
Arginine		1.69		1.68		1.70		1.71		1.70	
Histidine		0.76		0.73		0.72		0.71		0.69	
Lysine	0.80	2.30	35	2.10	38	2.02	40	1.94	41	1.84	44
Cystine		0.34		0.43		049		0.54		0.59	
Tryptophan	0.25	0.32	78	0.31	81	0.30	83	0.29	86	0.29	86
P.S./150 for methinone		85		78		75		72		70	
P.S.		125.46		110.00		102.73		96.36		91.82	

G.D.R. : grams consumed to meet the individual essential amino acids daily requirements for man.

P.S./150 for methionine : Percent satisfaction of methionine daily needs for man when consuming 150 g of product.

P.S. : Percent satisfaction of the methionine daily needs for man when G.D.R. value for protein is consumed.

Table 5. Physical characteristics of beefburgers as affected by the level of F. P.I. (WW).

Indices \ Samples (levle of F.P.I. %)		0%	10%	15%	20%	25%
	PWFC	0.1761	0.1854	0.1901	0.1947	0.1996
	Plasticity $\frac{Cm^2}{Cm^2 /1gm\ T.N}$	3.5 / 508	3.5 / 486	3.4 / 463	3.3 / 440	3.2 / 418
	W H C $\frac{Cm^2}{\%\ bound\ water}$	3.9 / 81.89	3.5 / 83.65	3.3 / 84.53	3.0 / 85.90	2.9 / 86.32
	Cooking $\frac{Loss\ \%}{Yield\ \%}$	22.95 / 77.05	20.12 / 79.88	18.63 / 81.37	16.75 / 83.25	15.46 / 84.54
	Feder value	3.59	3.44	3.36	3.29	3.22
	PWFC	0.3696	0.3901	0.4071	0.4238	0.4337
	Plasticity $\frac{Cm^2}{Cm^2 /1gm\ T.N}$	3.3 / 272	3.3 / 261	3.2 / 246	3.2 / 238	3.0 / 220
	W H C $\frac{Cm^2}{\%\ bound\ water}$	4.6 / 66.41	4.3 / 70.49	3.9 / 74.07	3.5 / 77.63	3.3 / 79.43

PWFC : Protein - water fat coefficient ($\frac{\%\ Protein}{\%\ Water + \%\ fat}$)

T.N. : total nitrogen

WHC: water holding capacity

150g of fried 20% or 25% F.P.I. products were consumed indicating that both are of high nutritional value . Under the same conditions the threionine daily requirements for man will be met at 342% and 336% for both samples respectively, and requirements in all other EAA will be met completely. Thus, upon consumption of 150 g fried 25% F.P.I. burgers, the percent of covering the daily requirements of EAA will be met at the following levels : Leucine 312% , isoleucine 304% , phenylalanine 151%, valine 268%, methionine 70%, threonine 336%, lysine 345% and tryptophan 174% indicating the high nutritional value of 25% F.P.I. sample. This is realized because when consuming 150 gm of fried product threonine the daily requirements for man (deficient in protein) will be covered in excess.

C-Physical characteristics

From the results in Table 5 it could be observed that as indicated by plasticity and PWFC values , the tenderness of uncooked and fried burgers showed some decrease as the level of F.P.I. increased . But it seems that up to 20% F.P.I. the decrease of tenderness not observed. Feder value (being below 4.0 for all samples) indicated the good quality of all products. Tenderness and WHC were decreased by frying possibly because of protein denaturation and aggregation by heating (Kriloba and Liskovskaia, 1968). But WHC being improved by increasing F.P.I. level in uncooked and fried samples, would be due to improvement of WHC. By increasing F.P.I. level, cooking loss decrease, and cooking yield increase.

D-Organoleptic evaluation

Data in Table 6 show that up to 20% F.P.I. level no changes occurred in aroma, taste , colour and overall acceptability while texture scores decreased from 9 to 8. Both scores however rated very good according to the used scale . At 25% F.P.I., level scores for all studied factors rated "very good" (8-9 scores) , except for texture (7scores) which ranked good. Therefore, 25% F.P.I. sample was also of good quality. However, for processing beefburgers of maximum quality with slight deficiency in threonine and slight decrease in texture grade (25% F.P.I. sample), it is enough to replace 20% of beef with equal proportion of diluted F. P. I.

Table 6. Average scores for organoleptic properties of fried beefburgers as affected by the level of F.P.I.

Samples (levle of F.P.I. %) / Factors	0%	0%	0%	0%	0%
Aroma	9	9	9	9	8
Taste	9	9	9	9	8
Colour	9	9	9	9	9
Texture	9	9	9	9	7
Overall acceptability	9	9	9	9	8

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الاستفاده من ريش الدواجن في الطعام وفي العلائق : ٥- القيمة الغذائية والخواص الطبيعية للبيف بورجر المجهز مع نسب مختلفه من البروتين المفصول من ريش الدجاج المحلل

نبيلة يوسف الصنافيري

١ - قسم بحوث تكنولوجيا اللحوم والأسماك - المعمل المركزي لبحوث الصناعات الزراعيه مزكز البحوث الزراعيه.

البروتين المفصول من ريش الدجاج المحلل مائيا بالبوتاسا الكاوية والمرسب عند نقطه التعادل الكهربي بحامض الأرثوفوسفوريك استخدم ليحل محل صفر ، ١٠، ١٥، ٢٠، ٢٥٪ من اللحم البقري في البيف بورجر بعد تخفيف البروتين المفصول أولاً بالماء بنسبه ٢:١. ولقد ازدادت نسبة البروتين نوعا ما في البورجر المقلي مع زياده نسبه البروتين المفصول فيه ، وحتي مستوي ٢٠٪ بروتين ريش مفصول لم يحدث نقص في بروتين البورجر المقلي بالنسبة لأي من الأحماض الأمينية الأساسية بناء علي حساب نسبه كل حامض اساسي الي مثيله في البروتين الدليل لهيئة الأغذية والزراعة ، ولكن علي مستوي ٢٥٪ بروتين ريشي مفصول لوحظ نقص طفيف (في حدود ٢٪) في الثريونين . وقد كان الانخفاض في القيم الحسابيه لدليل أو سر الأحماض الأمينيه الاساسية والقيمة البيولوجيه للبروتين ونسبه كفاءة البروتين غير كبير مع زياده نسبه استبدال اللحم البقري ببروتين الريش المفصول في البيف بورجر. وكان عدد الجرامات اللازم استهلاكها لتغطية الاحتياج اليومي للرجل البالغ من البروتين كانت تقل بينما تزيد الكميه المطلوب استهلاكها لتغطيه الإحتياج اليومي من المثيونين اعلي منها بالنسبه لباقي الاحماض الأمينيه الاساسيه . وعند استهلاك ١٥٠ جرام من البيف بورجر المقلي المجهز مع ٢٥٪ بروتين ريش مفصول فان الاحتياج اليومي للرجل البالغ من البروتين والمثيونين يتم تغطيتها علي مستوي ٧٦٪ ، ٧٠٪ علي التوالي وهذه تعتبر قيم مرتفعه بدرجة كافيه (تم تغطيه أكثر من ١/٢ الاحتياجات اليومية من وجبه واحده). ومع زيادة بروتين الريش المفصول في البورجر الطازج والمقلي تزداد القدره علي امساك الماء ويزداد مقدار الناتج بالطهي ويقل الفقد بالطهي كما تقل الطراوه نوعا ما بناء علي قياس البلاستيكية وحساب قيم معامل « البروتين - ماء دهن » ، وعلي مستوي ٢٥٪ بروتين ريش مفصول كانت درجات الاختبار الحسي للرائحة والطعم واللون والتقبل العام مرتفعه بدرجة كبيرة (قيمت جيدا جداً، ٨-٩ درجات) ولكن لحدوث نقص قليل في القوام (حصل علي تقييم جيد ٧ درجات) يكفي استبدال ٢٠٪ من اللحم البقري بنسبة مماثله من بروتين ريش الدجاج المفصول المخفف.