READY TO EAT, NOURISHING AND ECONOMICAL CHICKEN LOAF

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Abstract

Cooked chicken loaves with or without defatted soy flour could participate in solving lack of meat products that are expensive food items for they provide economy proteinaceous foods prepared from lesser value chicken leg quarters with partial replacement of meat with vegetables, tightly packaged in aluminum foil, oven cooked in presence of water vapor and cool preserved up to 6 weeks – as confirmed by the results of this investigation - which might be considered more than enough to be safely marketed and consumed.

In this research, formulas were adjusted to produce Egyptian style taste, proteinaceous and low fat meat product where 18% of the animal protein was substituted with plant protein. This also favored the carbohydrate, ash, fiber, moisture, iron and β carotene contents of the final product and lessened much of its cooking loss. Addition of soy also improved tenderness and, in cooperation with the special properties of ovine meat contents, reduced spoiling indices (T.V.N. and TBA). Cooking with moist heat resulted in no colony forming units, which is reflected in full 6 weeks of preservation under cooling condition. Biological value of cool stored loaves after 6 weeks was far beyond threshold. Results of sensory evaluation indicated similarities among control and soy samples of chicken loaves that also proved economy when compared with other meat products available to consumers in the Egyptian market.

This product is applicable at home, factories of chicken products and chicken slaughter-houses provided with few and inexpensive equipment. Conveniency will be achieved for Egyptians of all ages when it is served hot or cold and when it is produced in small size packages.

Keywords: chicken loaf, chicken loaves, economical chicken products.

INTRODUCTION

Manufacture of economy, nourishing and ready to eat foods is considerable for the developing countries, where men and women work to raise family standard of living. Chicken leg quarters are cheap dietary source of animal protein, Fe and niacin as well as riboflavin and Zn, in addition, poultry meat worldwide is becoming the most popular meat and its demand has a high income elasticity particularly in developing

countries (*Roenigk*, 1998). Shredded carrots, a mixture of green and red peppers cut into small pieces and seedless pickled green olives cut into halves are added to the formula to maintain natural sources of fibers and some micronutrients [e.g. provitamin A – which is considered short in the Egyptian family meals (*FNM*, 2002) – and minerals]. Apart from the control sample, defatted extruded soy flour, which is a rich source in plant protein, carbohydrates, with emulsifying and stabilizing properties and cheap (*Lecomte et al.* 1993), was added into the formula to substitute 18% of its meat content. The main goals of this work are to provide a cheap fast food model and rich in all the necessary nutrients with longer shelf life.

MATERIALS AND METHODS

Broiler chicken (*Gallus domesticus*) leg quarters were purchased fresh from the local markets, deboned and skinned. The meat was then individually minced twice through an 0.250 inch (0.62 cm) plate then through 0.125 inch (0.31 cm) plate laboratory grinder. Table (1) indicates the weight and percentage at which each ingredient was incorporated into the formula of different chicken loaves.

For making chicken loaf; salt was added to ground chicken in the bowl of a dough mixer and they were mixed together for one minute. The fresh vegetable pieces plus the whole black peppers were breaded in little gelatin powder before they were added with all other ingredients into the bowl and the mixing was continued for about 2 minutes more. The batter was then moulded cylindrically -10 cm diameter- in two layers of aluminum foil, which were then tightly, wrapped vice-versa. Cooking and sterilizing was done in an ordinary oven at 160°C for 75 min in the existence of a water bath along the cooking period (steam heat at ambient pressure). The loaves were then left to cool to ambient temperature and kept in a refrigerator at 5°C for 6 weeks. The samples were subjected to analysis at fresh and 6 week old of refrigerated storage, which is considered long enough to be marketed and consumed.

Moisture, protein, fat, ash, Fe and fiber content were determined according to (*A.O.A.C.*, 1990). Carbohydrates content was calculated by difference. β carotene was determined according to the modification suggested by *Umieland Gabelman*, (1971). Cooking loss was determined as follows: samples were weighed before and after heat treatment, the cooking loss was calculated as percentage of the initial weight. Feder value was calculated according to *Pearson et al.* (1984). The energy value was

calculated by multiplying the protein plus carbohydrates contents by 4 and fat content by 9. Amino acid scores (A.S.) were calculated in relation to the *FAO/WHO/UNU,* (1985) reference protein. Grams daily requirement (G.D.R.) of protein and energy were calculated using USRDA (*RDA,* 1989), which recommended 63g for protein and 2900 k cal for energy for adult man per day. Highest G.D.R. value indicates the restricting amino acid that when anyone consumes all his daily needs in all essential amino acids will be covered. P.S./150 (Percent Satisfaction of the daily requirements of adult man in protein and energy when 150g of product is consumed, was also calculated using *RDA,* (1989). pH value was measured in a slurry according to *Krilova and Liskovskaia,* (1960). Water holding capacity (W.H.C.) and plasticity were measured according to the method described by *Volovinskaia and Merkolova,* (1958). Total volatile Nitrogen (T.V.N.) was determined according to *Winton and Winton,* (1958). Thiobarbituric acid (TBA) was estimated as described by *Pearson et al.* (1984). Total aerobic bacterial count (TABC) was followed up according to *Thabet,* (1967). Coliform group was also examined according to the previous reference. Individual amino acids were determined using HPLC Sys. Beckman (System gold, programmable solvent module 126). Essential Amino acid index (EAAI) and biological value (B.V.) were calculated according to *Oser,* (1959). Protein water coefficient (PWC) and protein water fat coefficient (PWFC) were calculated according to *Tsuladze,* (1972) where PWC = %protein / %moisture and PWFC = %protein / % moisture + %fat. The sensory evaluation was carried out by aid of 20 panelists with the following judging score: very good (8-9), good (6-7), fair (4-5), poor (2-3) and very poor (0-1) according to *Watts et al.* (1989). Analysis of variance with F test and least square differences were used to identify significant differences ($P<0.05$) among treatments (shown under the dotted lines in table 5) using a statistical computer program (SAS).

RESULTS AND DISCUSSION

- It is obvious that formulas in table (1) resulted in preoteinaceous chicken loaves. This was assured by analysis in table (2), where analysis of uncooked control and samples are omitted to concentrate on what consumers care for. From table (2), chicken loaves are also low fat. Substituting up to 18% of animal protein with plant protein does not affect previous ideas, this also resulted in more carbohydrates, ash, fibers, moisture, water holding capacity and very low cooking loss. Consuming 150g (P.S./150) of cooked chicken loaves provides the adult with 40.71 – 49.95%

of his daily needs from protein. According to *F.N.M.*, (2002) iron and vitamin A are considered short in the Egyptian family meals, so when 100g of cooked chicken loaf contain at least 1.75mg iron and 0.15mg β carotene, then chicken loaves are considerable source of both of them (*RDA*, 1989 suggested 10mg iron as daily requirements for male adults & children and 1.0mg retinol = 6.0 mg β carotene for male adults). The increase in pH value beyond 6.0 in processed meats would improve protein and water binding (*Volovinskaia and Merkolova,* 1985), pH values of chicken loaves are compatible with the same idea.

- Texture indices (PWC, PWFC and Feder Value) plus W.H.C. (table 2), where less values mean more tenderness soy samples of cooked chicken loaves are always more tender than controls and this may be due to addition of soy flour in formula. Same result is reflected by plasticity values, where higher value means more tenderness. T.V.N. values even after 6 weeks of cold storage are very far from threshold level (30mg/100g), which was suggested by (*Woyewoda et al.* 1986). TBA values weren't also high, possibly because alkylphenols and thiophenol, which are naturally found at higher levels in ovine meat and act as antioxidants as indicated by *Rhee et al.* (1999), p.s. threshold level of TBA is 0.9mg/kg according to most of the Egyptian Standards (ES) for meat products (e.g. ES 2097/1992 for ground beef with soy and ES 2911/1995 for chicken and turkey sausage). Generally replacing meat with soy flour may also interfered with the decrease in T.V.N. and TBA. Assessment of TABC and coliform group (as indicator of pathogens) showed no colony forming units at all reflecting effectiveness of cooking treatment and packaging - previously mentioned – on the micro-organism contamination, which resulted in 6 weeks of cooling preservation in high quality.

- Results listed in table (4) lead to good protein quality. Concerning B.V., protein of soy sample at 0 time is almost the same as control (82.73% & 82.69%, respectively) that support the idea of substituting some meat with plant protein sources in meat products. All control and soy samples favor the human growth (B.V. > 70%) as indicated by *Robinson and Lawler*, (1982) even though B.V. is slightly reduced for cooled stored control and soy samples (82.42% & 82.37%, respectively). Values of A.S., shown in table (4), were all over 100 reflecting efficiency of essential amino acids of all chicken loaf samples, (according to *FAO/WHO/UNU*, 1985).

- It could be noticed (table 4) that in all prepared samples no deficiency was observed for all essential amino acids (EAA). Highest G.D.R. and lowest P.S./150 values, which shows the restricting amino acid (RAA), were found for histidine (table 4). Recorded G.D.R. values for RAA in zero time control, 6 week control, zero time soy sample and 6 week soy sample were 168.00, 165.25, 197.65 and 193.85, respectively. This indicates that the consumption of the previously mentioned amounts in grams of the same product totally covers the daily requirements of adult man in both RAA and EAA.
- Results of sensory evaluation are listed in table (5). Despite scoring ranged only between 7.0 and 8.5 for all characteristics, there is a significant difference ($P < 0.05$) among control sample and both of the soy samples at the level of overall acceptability while there is no significant difference ($P < 0.05$) between both of control samples and among 0 time soy sample and both of 6 week cool stored samples at the same level. The later case repeated at the level of average composite score twice, which indicates similarities among control and soy samples of chicken loaves. It is worth mentioning that most panelists remarked "tasty" on their judging sheets, which reflects Egyptian taste style formula.
- Figures listed in table (6) were calculated according to *Hassanein*, (1994). Prices were considered according to retail prices (per kg) dominant in December, 2003 in Egyptian Pounds (L.E.) as follows: 17.00 for chicken after skinning and deboning, 4.00 for rusk, 2.00 for fresh vegetables, 1.00 for salt, 20.00 for black pepper, 0.30 for 1 fresh egg x 40g, 0.50 for 10g mace and mixed spices, 0.25 for 50g fresh onion and 10g fresh garlic, 0.50 for casing, 0.35 for the quantity used of soy flour and 1.00 for oven cooking and refrigeration. One kg of chicken loaf is then sold to consumers at the average of 22.45 L.E. For additional comparisons 1 kg chicken luncheon or chicken hotdog costs 22-24 L.E. and 1 kg chicken frankfurter is for 18-20 L.E. at the retail price of Egyptian local markets.

REFERENCES

1- A.O.A.C. Association of Official Analytical Chemists 1990. Official Methods of Analysis, 15th ed., Washington DC, USA.

2- FAO/WHO/UNU, 1985. Energy and Protein Requirements, Reports of Joint FAO/WHO/UNU Expert Consultation, WHO Technical Report, Series 742, Geneva.

3- FNM, 2002. Following up the Nutritional Manner of the Egyptian Family Project, The Final Report. It's summarized in the report of Agric. Res. Cent. Board Meeting held on December 26th, 2002, Giza, Egypt.

4- Hassanein, Thanaa. 1994. Some new products from beef tongue. Res. Bull. Home Economics, Menoufiya Univ. 4(3) 21-32, Egypt.

5- Krilova, N. N. and Liskovskaia, V. N. 1960. Physical and Chemical Methods of Analysis of Animal products. Food Industry Pub. Moscow.

6- Lecomte, N. B., Zayas, J. F. and Kastner, C. L. 1993. Soya protein functional and sensory characteristics improved in comminuted meats. J. Food Sci. Vol. 58, No. 3, 464-466.

7- Oser, B. L. 1959. An integrated essential amino acid index (EAAI) predicting the biological value of protein and amino acid nutrition. Ed. A. A. Albanese, Academic Press, New York, USA.

8- Pearson, A. M., Kramlich, W. E. and Tauber, F. 1984. Processed Meats. AVI Pub. Co. Westport, Conn., USA.

9- RDA. 1989. Recommended Dietary Allowances. National Academy of Sci. National Res. Council, Washington DC, USA.

10- Rhee, K. S., Cho, S. H. and Pradahn, A. M. 1999. Composition, storage stability and sensory properties of expanded extrudates from blends of corn starch and goat meat, lamb, mutton, spent fowl meat, or beef. Meat Science 52(2), 135-141.

11- Robenson, C. and Lawler, M. 1982. Normal and Therapeutic Nutrition. McMillan Pub. Co. Inc., New York.

12- Roenigk, W. P. 1998. Poultry will overtake pig meat consumption. World Poultry 14(12), 14-16.

13- Thabet, F. M. S. 1967. Microbiological Studies on the Sardine Fish Prepared for Preservation with Special Reference to Bacteria Causing Spoilage in UAR. M. Sc. Thesis, Fac. Agric. Ain-Shams Univ. Egypt.

14- Tsuladze, E. A. 1972. The relationship between the tenderness of fish meat and its protein water and protein water fat coefficient. Fish Industry, 48(7): 68-69, Moscow.

15- Umiel, N. and Gabelman, W. H. 1971. Analytical procedure for detecting carotenoids of carrot root and tomato fruits. J. Am. Soc. Hortic. Sci. 96; 702. USA.

16- Volovinskaia, V. P. and Merkolova, V. K. 1958. Methods for the determination of water holding capacity of meat. Office Tech. Inf. & Propagation. Proceedings of All Union Sci. Res. Inst. Meat Industry. No. 21, Moscow.

17- Watts. B. M., Yamaki, G. L., Jefftey, L. E. and Elias, L. G. 1989. Basic Sensory Methods for Food evaluation. 1st ed. The International Development Res. Cent. Pub. Ottawa.

18- Winton, A. L. and Winton, R. B. 1958. (Okloff's magnesium oxide distillation volumetric method). The Analysis of Food, p. 848, John Willy, New York, USA.

19- Woyewoda, A. D.; Shaw, S. J.; Ke, P. J. and Burns, B. G. 1986. Recommended Laboratory Methods for Assessment of Fish Quality. Canadian Tech. Report of Fish and Aquatic Sci., No. 1448.

Table 1. Weight and percentage of ingredients used for preparation of control and soy sample for oven cooked chicken loaf.

Ingredients		Chicken leg quarters (ground)	Extruded soy flour (rehydrated)	Rusk (ground)	Carrots + green & red peppers + pickled green olives*	Salt	Whole black peppers	Fresh whole egg	Mace (ground)	Spices mix**	Onion (finely grated)	Garlic (finely grated)	Final mixture
Soy Sample	g	820	180	40	100	10	15	40	4	6	50	10	1275
	%	64.31	14.12	3.14	7.84	0.78	1.18	3.14	0.32	0.47	3.92	0.78	100
Control	g	1000	—	40	100	10	15	40	4	6	50	10	1275
	%	78.43	—	3.14	7.84	0.78	1.18	3.14	0.32	0.47	3.92	0.78	100

* A mixture of 1:1:1 by weight

** A mixture of nutmeg, marjoram, paprika, cardamom seeds and cloves at 1:1:1:0.5:0.5 by weight

Table 2. Analysis of zero time and 6 week cool stored control and soy samples for oven cooked chicken loaf.

Analysis		Zero time		6 week cool stored	
		Control	Soy sample	Control	Soy sample
Moisture %		61.45	62.32	60.15	61.10
Protein % (T.N. x 6.25)		20.45	17.10	20.98	17.66
Fat %		5.57	5.16	5.75	5.33
Ash %		1.61	1.66	1.64	1.68
Fibers %		1.34	1.36	1.37	1.38
Carbohydrates %		9.58	12.40	10.11	12.85
Cooking loss %		3.32	2.88	3.40	2.94
Energy value (k cal/100g)		170.25	164.44	176.11	170.01
P.S./150	For protein %	48.69	40.71	49.95	42.05
	For energy %	8.81	8.51	9.11	8.79
Iron mg/100g		1.87	1.75	1.88	1.76
β carotene mg/100g		0.15	0.18	0.15	0.18
pH		6.25	6.36	6.31	6.40
W. H. C. cm^2/0.3g		4.34	4.71	4.40	4.15
Plasticity cm^2/0.3g		2.78	2.90	2.71	2.84
PWC		0.333	0.274	0.349	0.289
PWFC		0.305	0.253	0.318	0.266
Feder Value		1.96	2.02	1.85	1.92
T. V. N. mg/100g		3.20	2.85	4.89	4.40
TBA mg/1000g		0.17	0.15	0.51	0.44
TABC cfu/g		Nil	Nil	Nil	Nil
Coliform group cfu/g		Nil	Nil	Nil	Nil

All figures are on wet weight basis

Table 3. Amino acid profile of zero time and 6 week cool stored control and soy samples for oven cooked chicken loaf.

Amino acid	Ile	Leu	Lys	Met	Sys	Phe	Tyr	Thr	Trp	Val	Arg	His	Ala	Glu	Gly	Asp	Pro	Ser
Control Zero time	5.18	7.83	7.71	2.37	1.57	4.51	3.50	4.17	1.21	5.64	6.25	2.93	6.00	15.66	4.39	9.85	4.56	5.12
Soy Sample Zero time	5.15	7.80	7.83	2.32	1.54	4.30	3.69	4.13	1.22	5.71	6.15	2.96	6.14	15.80	4.31	9.76	4.49	5.06
Control 6 weeks	5.18	7.84	7.68	2.36	1.55	4.52	3.50	4.15	1.20	5.64	6.22	2.92	5.98	15.53	4.36	9.84	4.51	5.10
Soy Sample 6 weeks	5.14	7.82	7.81	2.31	1.53	4.32	3.68	4.10	1.20	5.72	6.18	2.94	6.13	15.67	4.29	9.76	4.45	5.05

All figures are in g/16g nitrogen

Table 4. Some nutritive properties of zero time and 6 week cool stored and soy samples for oven cooked chicken loaf.

Essential amino acids	FAO/WHO/UNU* reference protein g/16g nitrogen	g/16g nitrogen				Amino acid score				RDA**	g/100g loaf				G. D. R.				P.S./150			
		zero time control	6 week control	zero time soy sample	6 week soy sample	zero time control	6 week control	zero time soy sample	6 week soy sample		zero time control	6 week control	zero time soy sample	6 week soy sample	zero time control	6 week control	zero time soy sample	6 week soy sample	zero time control	6 week control	zero time soy sample	6 week soy sample
Leucine	1.9	7.83	7.84	7.80	7.82	412.11	412.63	410.53	411.58	1.197	1.60	1.65	1.33	1.38	74.81	72.55	90.00	86.74	200.50	206.77	166.67	172.93
Isoleucine	1.3	5.18	5.18	5.15	5.14	398.46	398.46	396.15	395.39	0.819	1.06	1.09	0.88	0.91	77.26	75.14	93.07	90.00	194.14	199.63	161.17	166.67
Lysine	1.6	7.71	7.68	7.83	7.81	481.88	480.00	489.38	488.13	1.008	1.58	1.61	1.34	1.38	63.80	62.61	75.22	73.04	235.12	239.58	199.41	205.36
Valine	1.3	5.64	5.64	5.71	5.72	433.85	433.85	439.23	440.00	0.819	1.15	1.18	0.98	1.01	71.22	69.41	83.57	81.09	210.62	216.12	179.49	184.98
Threonine	0.9	4.17	4.15	4.13	4.10	463.33	461.11	458.89	356.56	0.567	0.85	0.87	0.71	0.72	66.71	65.17	79.86	78.75	224.87	230.16	187.83	190.48
Tryptophan	0.5	1.21	1.20	1.22	1.20	242.00	240.00	244.00	240.00	0.315	0.25	0.25	0.21	0.21	126.00	126.00	150.00	150.00	119.05	119.05	100.00	100.00
Methionine + Cystine	1.7	3.94	3.91	3.86	3.84	231.77	230.00	227.06	225.88	1.071	0.80	0.82	0.66	0.68	133.88	130.61	162.27	157.50	112.04	114.85	92.44	95.24
Phenylalanine + Tyrosine	1.9	8.01	8.02	7.99	8.00	421.58	422.11	420.53	421.05	1.197	1.64	1.68	1.37	1.41	72.99	71.25	87.37	84.89	205.51	210.53	171.68	176.69
Histidine	1.6	2.93	2.92	2.96	2.94	183.13	182.50	185.00	183.75	1.008	0.60	0.61	0.51	0.52	168.00[I]	165.25[I]	197.65[I]	193.85[I]	89.29	90.77	75.89	77.38

* FAO/WHO/UNU. (1985)

** RDA. (1989). Daily requirements for adult men

I = Restricting amino acid (RAA)

EAAI (zero time control) = 86.62

EAAI (6 week control) = 86.38

EAAI (zero time soy sample) = 86.66

EAAI (6 week soy sample) = 86.33

B.V. (zero time control) = 82.69%

B.V. (6 week control) = 82.42%

B.V. (zero time soy sample) = 82.73%

B.V. (6 week soy sample) = 82.37%

Table 5. Sensory characteristics of control and soy samples for oven cooked chicken loaf.

Characteristics	Zero time		6 week cool stored	
	Control	Soy sample	Control	Soy sample
Color	8.0	8.0	7.5	7.5
Odor	8.0	7.5	7.5	7.0
Taste	7.5	7.0	8.0	7.0
Texture	8.5	8.0	8.5	8.0
Overall acceptability	8.5	8.0	8.0	7.5
	8.50a	7.96b	8.02ab	7.54cb
Composite score*	40.50	38.50	39.00	37.00
Average composite score	8.1	7.7	7.8	7.4
	8.11a	7.70ab	7.77ab	7.43b

* sum score of color + odor + taste + texture + overall acceptability

Table 6. Production costs and consumer price for oven cooked sample of chicken loaf.

Costs	L.E.
Raw materials (1.235 kg on the average after cooking)	21.00
Industrial & administrative expenses (20% of raw materials)	4.20
Total production cost	25.20
Profit (10% of total production cost)	2.52
Consumer price/1.235 kg cooked loaf	27.72
Consumer price/1.0 kg cooked loaf	22.45

رغيف لحم الدجاج الاقتصادى المغذى الجاهز للاكل

احمد ناجى وهدان

معهد بحوث تكنولوجيا الاغذية – مركز البحوث الزراعية بالجيزة ، مصر

يمكن أن تساهم أرغفة لحم الدجاج المحتوية أو غير المحتوية على دقيق الصويا منزوع الدهن فى حل مشكلة نقص مصنعات اللحوم الغالية وذلك لانها من الاغذية البروتنية الاقتصادية المعده من أرباع الدجاج الخلفية زهيدة الثمن مع استبدال جزئى للحم بمصادر بروتين نباتية ثم تغلف باحكام فى لفائف من رقائق الالومنيوم وتطهى فى وجود بخار الماء ثم تحفظ بالتبريد حتى ستة أسابيع وهى مدة يعتقد أنها أكثر من كافية لتسويقها واستهلاكها بأمان.

تم ضبط التوليفات طبقا للمذاق المصرى وللحصول على منتج بروتينى منخفض فى نسبة الدهن حيث تم استبدال ١٨% من البروتين الحيوانى بالبروتين النباتى وذلك أدى الى زيادة محتوى المنتج النهائى فى الكربوهيدرات ، الرماد ، الالياف ، الرطوبة ، الحديد ، بيتا كاروتين كما قلل من الفقد بالطبخ. حسنت اضافة الصويا مع الخصائص المميزة للحم الطيور من الطراوة والقيم الدالة على الفساد (النيتروجين الطيار الكلى وحمض ثيوباربتيوريك). وترتب على الطهى بالحرارة الرطبة – كما أثبتت نتائج الدراسة – عدم وجود مستعمرات بكتيرية مما أدى الى اطالة مدة الحفظ الى ٦ أسابيع تحت ظروف التبريد. وكانت القيمة الحيوية للارغفة مرتفعة حتى بعد الاسابيع الستة. وأظهر اختبار التذوق عدم وجود فروق معنوية بين الكنترول وعينة الصويا وتميزت الاخيرة أيضا بتكلفتها المنخفضة عند مقارنتها بمصنعات اللحوم الاخرى المتاحة فى الاسواق للمستهلك المصرى.

يعتبر هذا المنتج قابلا للتطبيق فى المنازل ومصانع منتجات الدجاج وحتى فى مجازر الدواجن المزودة بقليل من المعدات غير المكلفة. كما يعتبر ملائما عند تقديمه ساخنا أو باردا فى عبوات صغيرة الحجم.