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CHEMICAL ANALYSIS OF CHICKEN MEAT WITH RELATION TO ITS QUALITY

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A B S T R A C T

A total of 105 random samples of chicken cuts up were collected from different super markets located in Menoufiya governorate. The examined samples were breast, thigh and drumsticks (35 of each). The samples were taken as intact units and transferred immediately in an ice box to the laboratory with undue delay in order to investigate their chemical criteria. The obtained results indicated that the mean values of moisture content (%) in the examined samples of chicken breast, thigh and drumsticks were 74.31 ± 0.18, 72.89 ± 0.21 and 71.14 ± 0.16; protein contents (%) were 21.06 ± 0.18, 20.13 ± 0.21 and 18.42 ± 0.16; fat contents (%) were 2.25±0.09, 2.99 ± 0.10 and 4.61 ± 0.13; ash contents (%) were 2.37±0.05, 2.52 ± 0.06 and 3.56 ± 0.09, respectively. Application of some keeping quality tests declared that the mean values of pH ,T V N (mg %) and T B A (mg %) on the examined samples were 5.91 ± 0.01, 11.29 ± 0.32 and 0.04 ± 0.01 for chicken breast, 5.77± 0.01, 8.10 ± 0.21 and 0.09± 0.01 for thigh and 5.98 ± 0.01, 6.57 ± 0.19 and 0.14 ± 0.01 for chicken drumsticks, respectively. On the other hand, chicken breast had the highest content of Glutamic acid (12.82), Alanine (10.27), Methionine (9.11), Lysine (8.52), Arginine (6.61), Tryptophan (6.29), phenylalanine (4.79) and serine (3.48) than the other examined samples. In the same time, chicken thigh had the highest content of Glycine (14.69), Valine (8.19) and proline (6.01). While chicken drum stick had the highest content only of Leucine (13.45), Aspartic acid (10.12), Threonine (6.55), Tyrosine (5.07) and hydroxyproline. (2.21) Regarding the examined samples of chicken breast , thigh and drumstick, the total unsaturated fatty acids were 46.2%, 42.5% and 39.10%, however the total saturated fatty acids were 53.4%, 57.5% and 60.9% and the ratios between them were 0.91, 0.74 and 0.64 , respectively.

KEY WORDS: Chemical analysis, chicken cuts-up, shelf life, spoilage.

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1. INTRODUCTION

Chicken meat is a good source of protein and many nutrients and relatively low in fat, especially when skin is removed. Chicken meat is also characterized by versatility in menu planning, ease of preparation, consistent quality and the availability of a wide range of pre-packaged, branded, raw and ready to eat and serve products [23].

Chicken and chicken cuts- up are good source of animal protein of high biological value, which contains all the essential amino acids required for human nutrition. Amino acid content of chicken meat components as being a part of chicken cuts- up can play a significant role in meat identification [13]. Besides that chicken meat, contain higher proportion of unsaturated fatty acids and less cholesterol. Chicken meat can be sold as a whole carcass or ready- to- cook form. So, they may be sold as cuts- up, quartered or disjointed. Because of the high chicken meat yield, low shrinkage during cooking, ease of cooking and serving and of low cost [8]. The chemical and nutritional compositions of chicken cuts-up are greatly varied from one kind to another

[15]. Therefore, the aim of the present investigation was to evaluate the chemical quality of frozen chicken cuts- up (chicken breasts, chickens thighs and chickens drumsticks) via determination of moisture, protein, fat, ash, pH, TVN, TBA, amino acid and fatty acid fractions.

2. MATERIAL AND METHODS

2.1. *Collection of samples*:
A total of 105 random samples of frozen chicken cuts-up (breast, thigh and drumstick) represented by 35 samples of each were collected from different supermarkets in Menoufiya government, each sample weighting 250gm. All collected samples were aseptically transferred; without undue delay in an insulated ice box to the laboratory and then subjected to the following examinations.

2.2. *Chemical examinations*:
Determination of moisture, protein content, fat and ash content was done according to AOAC [6]. Determination of pH was performed according to Pearson [20]. Determination of Total Volatile Nitrogen (TVN) was done according to *FAO* [10]. Determination of Thiobarbituric acid number (TBA) was done according to Vyncke [25]. Amino acid profile was determined according to Mabbott [18]. Fatty acid profile: was done after Extraction of fat from meat [6] and Isolation and extraction of fatty acids according to AOCS [4]. Identification and determination of fatty acids was done according to Aura *et al*. [7]. Methylation of fatty acids was determined according to Vogel [24].

3. RESULTS AND DISCUSSION

Concerning the results recorded in table 1 that the mean values of moisture content (%) in the examined samples of chicken breast, thigh and drumsticks were 74.31 ± 0.18, 72.89 ± 0.21 and 71.14 ± 0.16; 21.06 ± 0.18, 20.13 ± 0.21 and 18.42 ± 0.16 for protein content (%) ; 2.25 ± 0.9, 2.99 ± 0.10 and 4.6 ± 0.13 for fat content(%)and 2.37 ± 0.05, 2.52 ± 0.06 and 3.56 ± 0.09 for ash content (%), respectively. The rock cornish hens contained a higher amount of moisture than the broilers, also thigh meat had a higher moisture content than breast before cooking, while after cooking the breast meat was higher in moisture **[11].**

Table 1 Mean values of moisture, protein, fat and ash%, in the examined samples of chicken cuts-up (n=35).

Chicken cuts-up	Mean ± S.E			
	Moisture	Protein	Fat	Ash
Chicken breast	74.31 ± 0.18	21.06 ± 0.18	2.25 ± 0.09	2.37 ± 0.05
Chicken thigh	72.89 ± 0.21	20.13 ± 0.21	2.99 ± 0.10	2.52 ± 0.06
Chicken drumstick	71.14 ± 0.16	18.42 ± 0.16	4.61 ± 0.13	3.56 ± 0.09

Table 2 Mean values of pH, TVN mg % and TBA mg % in the examined samples of chicken cuts-up (n=35).

Chicken cuts-up	Mean ± S.E		
	pH	TVN	TBA
Chicken breast	5.91 ± 0.01	11.29 ± 0.32	0.04 ± 0.01
Chicken thigh	5.77 ± 0.01	8.10 ± 0.21	0.09 ± 0.01
Chicken drumstick	5.98 ± 0.01	6.57 ± 0.19	0.14 ± 0.01

The concentration of crude protein and minerals in muscles depended upon protein source and was higher than the soy bean meal protein [21]. The stability of lipids of dark and white chicken muscle during frozen storage at – 18ºC for 12 months, revealed some changes in total lipids due to the loss of triglycerides, lipids showing higher stability by white chicken than dark chicken meat [12]. The ash content of muscle tissue is approximately 1%. [16]. Results achieved in table 2 indicated that the mean values of pH in the examined chicken breast, thigh and drumstick samples were 5.91±0.01, 5.77±0.01 and 5.98±0.01, 11.29±0.32, 8.10±0.21 and 6.57±0.19 of TVN mg/% and 0.04±0.01, 0.09±0.01 and 0.14±0.01 of TBA mg/%, respectively. The chicken meat with pH below 5.8 had a pale color, while chicken meat with higher pH, the color was too dark and it has a great risk on human health. So, the ideal pH for meat is between 5.8 and 6.3 [19]

The pH of the broiler breast muscles was lower than the pH of hen breast muscle and pH of breast muscles was lower than that of the thigh muscle for both classes [17]. The decrease in pH value in meat may be attributed to the break down of glycogen with formation of lactic acid and the increase of pH that may be due to the partial proteolysis leading to the increase of free alkaline groups depending on the condition of such changes. Besides, higher pH values of leg meat compared to breast meat could be due to the increase of lactic acid concentration via anaerobic metabolism in breast meat [14]. The variations in the broiler breast meat color, due to pH, can be related to differences in the shelf life of the product, higher muscle pH produced conditions that make it dark. Colored fillets when held in the same refrigerated storage conditions [3]. Moreover, TVN can be considered as a reliable indicative measure for the quality of various food articles especially chicken meat and chicken cut-up meat. In general, TVN in chicken cut-up meat may be increased as the days of storage increased [22].

Table 3_Fractionation of amino acid contents (average %) in the examined samples of different chicken cuts-up (n=35).

Amino acids	Chicken cuts-up		
	Chicken breast	Chicken thigh	Chicken drumstick
Alanine	10.27	5.65	7.09
Arginine	6.61	3.18	4.25
Aspartic acid	7.94	9.33	10.12
Glutamic acid	12.82	10.47	8.99
Glycine	8.06	14.69	9.37
Hydroxyproline	-	0.87	2.21
Leucine	4.13	9.62	13.45
Lysine	8.52	5.10	2.73
Methionine	9.11	4.57	7.66
Phenylalanine	4.79	1.94	1.35
Proline	5.26	6.01	3.72
Serine	3.48	2.36	2.14
Threonine	1.24	3.97	6.55
Tryptophan	6.29	2.26	0.73
Tyrosine	-	1.85	5.07
Valine	7.36	8.19	2.56

Generally, the product quality of processed meat is directly attributed to the quality of raw materials. Often meat for further processing has already been frozen, amplifying the effects of further freezing, storage and thawing. Additional ingredients are usually added which affect the quality, shelf-life and over all acceptability of these products and the physico-chemical reactions occurring during the freezing process **[9].**

The oxidative rancidity in fresh, frozen and cooked chicken breast and leg meat was evaluated by measuring malonaldehyde in fat with an improved thiobarbituric acid (TBA) assay with antioxidant protection **[1].**

Table 3 revealed that amino acid profile in the examined samples of chicken meat products showed marked differences between the examined samples in the amino acid composition. However, chicken breast had the highest content of Glutamic acid (12.82%), Alanine (10.27%), Methionine (9.11%), Lysine (8.52%), Glycine (8.06%), Aspartic acid (7.94%), Valine (7.36%), Arginine (6.61%), Tryptophan (6.29%),Proline (5.26%), Phenylalanine (4.79%), Leucine (4.13%) and Serine (3.48%) .

In the same time, chicken thigh had the highest content of Glycine (14.69%), Glutamic acid (10.47%), Leucine (9.62%), Aspartic acid (9.33%), Valine (8.19%), Proline (6.01%), Alanine (5.65%), Lysine (5.10%), Methionine (4.57%), Threonine (3.97%), Arginine (3.18%), Serine (2.36%), Tryptophan (2.26%), Phenylalanine (1.94%), Tyrosine (1.85%) and Hydroxyproline (0.87%). While, chicken drumstick had the highest content of Leucine (13.45%), Aspartic acid (10.12%), Glycine (9.37%), Glutamtic acid (8.99%), Methionine (7.66%), Alanine (7.09%), Threonine (6.55%), Tyrosine (5.07%), Arginine (4.25%), Proline (3.72%), Lysine (2.73%), Valine (2.56%), Hydroxyproline (2.21%), Serine (2.14%), Phenylalanine (1.35%) and Tryptophan (0.73%).

Table 4. Fractionation of fatty acid contents (average %) in the examined samples of different chicken cuts- up (n=35).

Fatty acids	Chicken cuts-up		
	Chicken breast	Chicken thigh	Chicken drum- stick
C 8:0	4.5	5.1	7.3
C 10:0	2.9	3.2	2.6
C 12:0	5.2	7.0	4.9
C 14:0	3.7	4.4	1.7
C 16:0	23.8	25.2	26.8
C 18:0	7.3	5.9	8.5
C 18:1	10.7	12.6	11.9
C 18:2	2.5	2.9	1.4
C 20:0	6.4	6.7	9.1
C 20:1	4.0	7.2	6.6
C 20:4	1.2	0.5	-
C 20:5	5.3	3.0	4.5
C 22:1	4.9	-	-
C 22:6	17.6	16.3	14.7
TU	46.2	42.5	39.1
TS	53.8	57.5	60.9
TU / TS	0.91	0.74	0.64

TU: Total unsaturated fatty acids TS: Total saturated fatty acids.

The amino acid profile is an important parameter because some amino acids cannot be synthesized by humans and must be obtained from diet. Chicken meat is rich in essential amino acids as Lysine, Leucine, Isoleucine and Sulfur – containing amino acids which considered as a high quality protein. Generally, 95-100% of protein from chicken meat and meat cuts-up are highly digestible **[2].** It is obvious from the results obtained in table 4 that the fatty acid contents (%) in the examined samples of chicken breast were 4.5 for C8:0, 2.9 for C10:0, 5.2 for C12:0, 3.7 for C14:0, 23.8 for C16:0, 7.3 for C18:0, 10.7 for C18:1, 2.5 for C18: 2, 6.4 for C20:0, 4.0 for C20:1, 1.2 for C20:4, 5.3 for C20:5, 4.9 for C22:1 and 17.6 for C22:6. Generally, total unsaturated fatty acids constituted 46.2%, however, total saturated ones were represented by 53.8 % and the ratio between them was 0.91.

The fatty acids contents (%) in the examined samples of chicken thigh were 5.1 for C8:0, 3.2 for C10:0, 7.0 for C12:0, 4.4 for C14:0, 25.2 for C16:0, 5.9 for C18:0, 12.6 for C18:1, 2.9 for C18:2, 6.7 for C20:0, 7.2 for C20:1, 0.5 for C20:4, 3.0 for C20:5 and 16.3 for C22:6. Thus, total unsaturated fatty acids were 42.5%, while the total saturated fatty acids were 57.5% and the ratio between them was 0.74.

Regarding the examined samples of chicken drumstick, the fatty acid contents (%) were 7.3 for C8:0, 2.6 for C10:0, 4.9 for C12:0, 1.7 for C14:0, 26.8 for C16:0, 8.5 for C18:0, 11.9 for C18:1, 1.4 for C18:2, 9.1 for C20:0, 6.6 for C20:1, 4.5 for C20:5 and 14.7 for C22:6. Thus, the total unsaturated fatty acid were 39.1%, while the total saturated fatty acids were 60.9% and the ratio between them was 0.64.

Generally, chicken cuts-up contains higher proportion of unsaturated fatty acids and less cholesterol. Oxidative deterioration results in loosing the quality of chicken meat due to development of rancid odor and taste. Moreover, the rancid flavor can develop rapidly during refrigerated or frozen storage of chicken cuts-up which are more susceptible to rancidity because of their high contents of unsaturated fatty acids **[5].** Cuts-up chicken meat provide to be an excellent food article prepared and considered as a good supplement of animal protein for a deficient diet.

From the achieved results, it is evident that chicken cuts-up in markets had their ingredients nearly within their permissible limits. So**,** strict control measures of the raw meat used in manufacturing of cuts-up meat and must be produced from healthy birds with special care of anti-mortem and postmortem inspections at all stages of preparation till the reconsider stages is deemed necessary

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مجلة بنها للعلوم الطبية البيطرية
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التحليل الكيميائي للحوم الدواجن وعلاقتها بالجودة

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الملخص العربي

تم تجميع بعض قطعيات لحوم الدواجن المجمدة من محلات السوبر ماركت بمحافظة المنوفية من أنواع الدجاج المجمدة مثل الصدور، الأوراك والدبوس. فقد تم تجميع105 عينة عشوائية (بواقع 35 عينة من كل نوع) من أماكن مختلفة و تحليلها كيميائيا لتقدير الحالة الكيميائية والصحية لهذه المنتجات. فقد كانت نسبة متوسط الرطوبة %، متوسط البروتين %، متوسط الدهن %، ومتوسط الرماد % هى 74.31+0.18، 21.06+0.18، 2.25+0.09و 2.37+0.05. في صدور الدجاج المجمد على التوالي، 72.89+0.21، 20.13+0.21، 2.99+0.1و 2.52+0.06 في أوراك الدجاج المجمد على التوالي، 71.14+0.16، 18.42+0.16، 4.61+0.13و 3.56+0.09 في دبوس الدجاج المجمد على التوالي. فى حين كانت نسبة متوسط تركيز أيون الهيدروجين، متوسط تركيز النيتروجين القلوى المتصاعد (مج / 100مجم) ومتوسط قيمة حمض الثيوباربيتيورك مجم/كجم (مالونالدهيد) هي 5.91+0.01، 11.29+0.32و 0.04+0.01 في صدور الدجاج المجمد، 5.77+0.01، 8.10+0.21 و 0.09+0.01 في منتجات اوراك الدجاج و 5.98+0.01، 6.57+0.19 و 0.14+0.01 في قطعيات دبوس الدجاج المجمد على التوالي. الأحماض الأمينية الموجودة فى قطعيات لحوم الدجاج المجمد:1) صدور الدجاج المجمد: ألانين (10.27) وأرجنين (6.61) واسبارتيك أسيد(7.94) وجلوتاميك أسيد (12.82) وجليسين(8.06) وليوسين(4.13) وليسين(8.52) وميثايونين(9.11) وفينيل الانين (4.79) وبرولين (5.26) وسيرين(3.48) وثيرونين (1.24) وتريبتوفان(6.29) وفالين (7.36) .2) أوراك الدجاج المجمد: الأنين(5.65) وأرجنين(3.18) وأسبارتيك أسيد (9.33) وجلوتاميك أسيد (10.47) وجليسين(14.69) وهيدروكسى برولين (0.87) وليوسين (9.62) وليسين (5.10) وميثايونين(4.57) وفينيل ألانين (1.94) وبرولين (6.01) وسيرين (2.36) وثيرونين(3.97) وتريبتوفان(2.26) وتيروسين (1.85) وفالين(8.19) .3) دبوس الدجاج المجمد: ألانين (7.09) وأرجنين(4.25) وأسبارتيك أسيد(10.12) وجلوتاميك أسيد (8.99) وجليسين(9.37) وهيدروكسى برولين (2.21) وليوسين (13.45) وليسين (2.73) وميثايونين(7.66) وفينيل ألانين (1.35) وبرولين (3.72) وسيرين (2.14) وثيرونين (6.55) وتريبتوفان (0.73) وتيروسين(5.07) وفالين (2.56). بالنسبة للأحماض الدهنية: كانت نسبة الأحماض الدهنية الغير مشبعة فى كل من صدور الدجاج المجمد، الأوراك والدبوس هى 42.5،46.2، 39.1 على التوالى وكانت نسبة الأحماض الدهنية المشبعة هى 53.8، 57.5، 60.9 على التوالى.

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