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CHARACTERISTICS OF CHICKEN MEAT AS AFFECTED BY DIFFERENT COOKING METHODS

Shedeed, Nagla A.*; S.A.S. Hallabo; F.A. El-Wakeil** and M.H. A. Shames El-Din***

*** Food Technology Dept. National Research Centre, Giza, Egypt.**

****Food Scince and Technology Dept, Fac.of Agric, Cairo, Egypt.**

ABSTRACT

The two investigated chicken meat parts, (i.e. breast and thigh) cooked by pressure and boiling, retained more moisture and total lipids than the cooked samples by roasting and microwave. On the other hand, chicken breast and thigh meats, cooked by pressure retained the highest percentages of total protein, total soluble protein (T.S.P)., soluble protein nitrogen (S.P.N)., soluble actomyosine nitrogen (S.A.N). and non protein nitrogen (N.P.N.) followed in a decreasing order by the microwave, roasting and boiling methods. Noticeable increase in the acid, peroxide and TBA values were found, especially in the case of either roasted chicken breast or thigh meat samples. Moreover, after any cooking method, breast meat samples showed lower acid, peroxide and TBA values than thigh meat samples. The highest increase in total saturated fatty acids were found in both roasted chicken breast and thigh meat samples, while the lowest increase in such percentages were observed in the same samples after pressure cooking as compared to the uncooked samples. The trend of total unsaturated fatty acids was found to be the reverse, compared to the saturated fatty acids. The chicken thigh meat samples had relatively higher unsaturated / saturated fatty acids ratios than chicken breast meat samples after any cooking method. Chicken breast and thigh meat samples cooked by pressure retained the highest amounts of total essential, non-essential and total amino acids, followed in a decreasing order by boiling, microwave and roasting methods, but no significant differences among these cooking methods for amino acid contents were found.

INTRODUCTION

In Egypt, chickens occupy a major place in production and consumption between poultry. It has become the second most popular meat eaten and is most likely to maintain this position. In the food industry, microwave are used for pasteurization of packaged products, for sterilization, tempering of frozen foods, precooking of poultry products and also snack foods (Sale, 1976 and Decareau, 1986), Microwave use become of great importance, because of its extensive utlization at homes for cooking, thawing and re-heating and also in research institutes for nutrient retention in processed foods (Mills and Morgan, 1990). The quality of raw cooked meat depends essentially on the composition and stability of the constituent lipids. In addition, the quality of protein after heat treatment was usually lower than expected. The freshly cooked muscles from a large variety of meat species were previously reported to have higher acid, peroxide and thiobarbituric acid (TBA) values than their fresh raw samples (Rhee, 1978; Newburg and Concon, 1980). Changes in the fatty acids composition of lipids provide an indirect measure of susceptability of lipid oxidation. In this respect the fatty acid changes in chicken meats during cooking could be the result of some chemical factors such as oxidation, hydrolysis and /or polymerization (Lee and Dawson, 1973). Cooking of either fresh breast or thigh meat samples causing some decrease in all their amino acids, might by attributed to their loss with drippings separated during cooking as well as by the heat destruction (Moawad, 1987 and Abd El-Gawad, *et al.*., 1988). The sensory attributes of chicken meat cooked in three ovens were evaluated by panelists rated the chicken meat cooked in the conventional oven as significantly more tender and juicy but similar in flavor intensity to chicken meat cooked in the microwave ovens (Barbeau and Schnept, 1989).

The puropse of this study was to evaluate the effects of microwave cooking as compared with the conventional heating methods on the stability of chicken white and dark meat. Also, to estimate the influence of used cooking methods on fatty and amino acids composition of chicken meat. Sensory evaluation of cooked chicken meat was also considered.

MATERIALS AND METHODS

Materials

Chicken broilers (8 weeks old, weight 1000-1200 g) were obtained from El-Zomor farm, Kalyoubia, Egypt. Brest (white meat), thigh (dark meat) were used in this study.

Methods

Technological Methods:

Preparation of chicken meat parts:

Chickens were slaughtered, plucked by hand, cleaned and washed with water. The wings, neck and heads were removed by hand. The carcasses were then cut into four parts (two breast pieces and two thighs).

Cooking methods:

Chicken parts (thighs and breasts) were cooked by the following methods:

Boiling:

Chicken parts (thighs and breasts) were cooked in sufficient amounts of boiling water to cover it at ratio 2 : 1 (water : chicken) for 30 minutes.

Pressure cooking:

Chicken parts (thighs and breasts) were placed in a pressure cooker and cooked for 20 minutes.

Roasting:

Chicken parts (thighs and breasts) were roasted by using a preheated conventional electric oven to 180 °C for 60 minutes.

Cooking by microwave oven:

Two thighs and two breasts were placed in a baking dish and cooked in a Gold Star Microwave Oven (Model ER-535 MD) (2450 MHz) on a high power level for 20 minutes, 10 minutes on one side and 10 on the other.

Preparation of chicken meat samples for analysis:

The raw, thawed and cooked chicken meat parts (thighs and breasts) were manually deboned cut into pieces and ground twice using a

Hobart meat grinder. The prepared samples were used for immediate analysis.

Analytical Methods:

Total lipids and total protein were determined according to the methods recommended by the A.O.A.C. (2000). All determinations were performed in triplicates and the mean values were reported.

Extraction of lipids from chicken meat samples:

Lipids were extracted from chicken meat samples by the method suggested and adopted by Bligh and Dyer (1959).

Chemical properties of chicken meat lipids:

Acid and peroxide values were determined according to the methods of the A.O.A.C. (2000).

Thiobarbituric acid (TBA) was determined according to the method described by Pearson (1981).

The TBA values (as mg malonaldehyde/kg sample) were calculated from the standard curve of malonaldehyde. All determinations were performed in triplicates and the mean values were reported.

Determination of fatty acids by G.L.C.:

Detector: Flame ionization.

Column: 1.5 m x 0.4 mm coiled glass column packed with 10% polyethylene glycol adipate on celite (100-120 mesh).

Carrier gas flow : - Nitrogen 30 ml./min. – Hydrogen 33 ml./min. - Air 330 ml./min.

Injector temperature : 220°C ***Chart speed :*** 1 cm/2 min

Column temperature: Isothermal 190°C ***Attenuation :*** 32×10^2

Detector temperature: 200°C

The method described by Metcalfe *et al.*. (1963) and Metcalfe and Wang (1981) was applied for the preparation of fatty acids methyl esters. A Pye Unicum GLC apparatus (series 104 Model 64, equipped with a hydrogen flame ionization detector available at the central lab., Faculty of Agriculture, Cairo University), was used for detecting the fatty acids. The following operating conditions were carefully selected to ensure precise calculations of the peaks and for separation of the peaks of the fatty acids.

The standard fatty acid mixture solution was used as primary reference during all the analysis carried out in this investigation.

Total nitrogen (T.N.):

Total nitrogen was determined in the studied chicken meat samples using the micro Kjeldahl procedure according to the method recommended in the A.O.A.C. (2000).

Nitrogenous compounds:

Total soluble nitrogen, soluble protein nitrogen and soluble actomyosin nitrogen were determined according to the methods reported by El-Gharabawi and Dugan (1965). Total soluble nitrogen (T.S.N.), soluble protein nitrogen (SPN), and soluble actomyosin nitrogen (SAN) were determined according to the methods of the A.O.A.C. (2000). Non-protein nitrogen (N.P.N.) was calculated according to Bodwell and McClain (1971), using the following equation:

N.P.N. = T.S.N. - S.P.N.

Amino acids determination:

Amino acids, other than tryptophan, proleine, cystine and methionine, were determined at the Central laboratory for the Food and Feed belonging to the Agriculture Research Center of the Egyptian Ministry of Agriculture. Acid hydrolysis was performed in sealed ampoules for the determination of amino acids

High Performance Amino Acid Analyzer (Beckman System 7300 and Data system 7000) was used as described by Moore *et al.*. (1958) and Widner and Eggum (1966).

Sensory evaluation and statistical analysis:

Ten panelists were asked to evaluate the cooked chicken meat parts (breast and thigh) for taste, juiciness, tenderness, flavor and over all acceptability. The mean values for each of the parameters in the organoleptic analysis were subjected to statistical analysis using analysis of variance and least significant difference (L.S.D.) as reported by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Effect of cooking methods on the chemical composition of fresh chicken:

The effect of cooking methods on the moisture, total protein, nitrogenous compounds, and total lipids contents in chicken white and dark meat was studied and the obtained results are shown in table (1). Data in table (1) shows that cooking methods of fresh chicken breast and thigh meat samples caused a noticeable decrease in their moisture content. The highest loss in moisture was observed in chicken breast and thigh meat cooked by microwave, being 14.57 and 16.63, respectively, followed by roasting being 12.99 and 14.58%, respectively. Similar results were achieved by Wing and Alexander (1972). Also, Baldwin *et al.*. (1976) found that, as the internal temperature cooked meat increased, the loss of moisture increased. Meanwhile, the lowest loss in moisture was found in chicken breast and thigh meat samples cooked by pressure being 7.34 and 8.46%, respectively. On the other hand, the two investigated chicken meat parts, cooked by pressure and boiling, retained more moisture than the other chicken meat samples cooked by microwave and roasting. This might be due to the possible absorption of some water during cooking by boiling or pressure, which could minimize the loss of water in the chicken meat, cooked by the two other methods. Abd Allah (1981) has earlier reported that boiling of fresh veal meat reduced the moisture content from 78.45% to 68.43%. Actually changes in moisture content during boiling depends on the meat / water ratio, used during boiling. Besides chicken breast meat showed a lower loss in moisture than thigh meat samples.

Table (1): Effect of cooking methods on the chemical composition of chicken meat parts (on dry weight basis)

Constituents (%)	Chicken white meat (breast)					Chicken dark meat (thigh)				
	Cooking methods					Cooking methods				
	Uncooked	Boiling	Pressure	Microwave	Roasting	Uncooked	Boiling	Pressure	Microwave	Roasting
Total protein	82.94	81.00	81.63	81.38	81.26	73.56	72.06	72.75	72.44	72.25
Nitrogenous compounds										
Total nitrogen (**T.N.**)	13.27	12.96	13.06	13.02	13.00	11.77	11.53	11.64	11.59	11.56
Total soluble nitrogen (**T.S.N.**)	10.59	5.84	6.38	6.25	6.15	8.83	5.28	5.71	5.63	5.54
Soluble protein nitrogen (**S.P.N.**)	8.92	3.98	4.34	4.26	4.19	7.45	3.73	4.00	3.95	3.88
Soluble actomyosin nitrogen (**S.A.N.**)	6.30	1.92	2.08	2.01	1.98	5.33	1.85	1.93	1.90	1.87
Non-protein nitrogen (**N.P.N.**)	1.65	1.86	2.04	1.99	1.96	1.38	1.55	1.71	1.68	1.66
Total lipids	12.18	11.76	11.97	11.65	11.47	21.65	20.95	21.11	20.57	20.18
Moisture	74.15	67.91	68.71	63.35	64.52	73.07	65.82	66.89	60.92	62.42

Similar results were found by Abd El-Wahed (1986). Furthermore, total nitrogen and protein of chicken breast and thigh meat samples, as affected by cooking methods, are represented in the same above mentioned table. The present results in the same table show that cooking of the investigated fresh chicken breast and thighs reduced their total nitrogen and protein content (on dry weight basis). Chicken breast and thigh meat samples cooked by pressure, retained the highest percent of total nitrogen and protein, followed, in a decreasing order, by microwave, roasting and boiling methods. These results are in accordance with those of Abd El-Wahed (1986). However, Lorenz (1976) has earlier found that microwave cooking caused less protein denaturation possibly because of less drip loss due to faster cooking time. Besides, from the previous results in (table 1), it could be further noticed that chicken breast and thigh meat cooked by pressure lost the lowest percent of their total nitrogen and protein contents, while the two investigated chicken meat parts cooked by boiling lost the highest percent of their total nitrogen and protein contents. Besides, cooking methods were found to affect the investigated protein fractions as follows: pressure < microwave < roasting < boiling. Similarly, Acton (1972) have earlier indicated a proportional relation between the internal temperature of cooked meat and the loss of protein solubility. From the same results (in table 1), it could be also noticed that the used cooking methods of either fresh chicken breast or thigh meat caused an apparent decrease in there total soluble nitrogen (T.S.N.), soluble protein nitrogen (S.P.N.) and soluble actomyosin nitrogen (S.A.N.), which might be due to the denaturation of protein which could have occurred during cooking. On the other hand, there was a noticeable increase in the non-protein nitrogen as a result of cooking. This increase is an indicator of some breakdown of the meat proteins Similar findings were reported by Ali (1974). Data representing the total lipids content of cooked chicken breast and thigh meat are also shown in table (1), from which it could be revealed that the total lipids content was found to decrease after cooking of both of the investigated breast and thigh samples on dry weight basis. The loss of lipids during the cooking process could have mainly occurred through the drippings, which are known to consist of natural lipids which melt out during the cooking process of ground meat (Keller and Kinsella, 1973). However, no significant differences were found among cooking methods for the amount of total lipids in either chicken breast or thigh meat. Cooked chicken breast meat samples had a lower loss of total lipids than chicken thigh meat samples. Similarly Drake *et al.*. (1975) recorded an increase in fat loss during cooking of ground beef as the initial amount of fat increased. The highest loss in total lipids contents was observed in chicken breast and thigh meats cooked by roasting, being 5.83 and 6.79% respectively. Meanwhile, the lowest loss in total lipids was found in chicken breast and thigh meat samples cooked by pressure, being 1.72 and 2.49% respectively. Similar results were reported by Shams El-Din and Ibrahim (1990).

Chemical properties of fat extracted from cooked chicken meat:

Acid, peroxide and TBA values for fat extracted from cooked chicken breast and thigh samples were assessed and the obtained results are shown in table (2).Data presented in table (2) shows noticeable increases in the acid, peroxide and TBA values, especially in the case of either roasted breast or thigh samples. Moreover, from the same obtained results it is apparent that after any cooking method breast meat samples showed lower acid, peroxide and TBA values than thigh meat samples. Previously Sharma *et al.*. (1982) as well as Shams El-Din and Ibrahim (1990) observed that cooking increased the free fatty acid levels. Also the extracted fat from chicken thigh meat had significantly higher acid, peroxide and TBA values than that obtained from chicken breast meat. The peroxide values of dark meat were previously found by Arafa and Chen (1976) to be higher than those of white meat and this was attributed to the presence of more lipids and hematin compounds in dark meat. Moreover, Acosta *et al.*. (1966) have earlier observed that the phospholipids fraction of total lipids was responsible for the oxidative deterioration in cooked turkey. The greater differences between cooking methods were attributed to the cooking conditions, especially heating time and temperature. Also, it is well known that the rate of a chemical reaction is directly related to prevailing temperature (Dawson and Gartner, 1983). Concerning the changes in TBA value (as an index of auto-oxidation), it was found that pressure cooking conditions, employed in the present study, increased the TBA number of breast meat samples to approximately 1.5 folds, while it increased for roasted breast meat to 2.3 folds. The effect of pressure cooking was found also to increase TBA number in thigh meat to about 2.0 folds, while the TBA value in the latter meat samples reached 3.0 folds after roasting as compared to the same raw samples. The above mentioned results are in close agreement with those previously reported by Webb *et al.*. (1972) and Dawson and Schierholz (1976), who referred to 3 folds increase in TBA number in cooked chicken meat. However, other authors reported 5 to 60 folds increase range in chicken meat TBA number after different cooking treatments (Shamberger *et al.*., 1974; Siu and Draper, 1978 as well as Newburg and Concon, 1980). Apparently, these fluctuating results could be due to differences in the cooking conditions and to the problem of sample autoxidation during peroxide and TBA analysis, associated with the probable enhancing by higher levels of oxidized lipids in cooked meat samples (Pikul *et al.*., 1984).

Table (2): Effect of cooking methods on the chemical properties of chicken meat fat.

Cooking methods	Chemical properties					
	Acid value (mg KOH/g fat)		Peroxide value (meq/kg fat)		TBA (mg malon-aldehyde/kg fat)	
	Breast	Thigh	Breast	Thigh	Breast	Thigh
Uncooked	0.63	0.80	0.96	1.22	0.28	0.36
Boiling	0.97	1.15	1.93	2.91	0.46	0.79
Pressure	0.84	0.98	1.67	2.48	0.41	0.71
Microwave	1.02	1.21	2.43	3.52	0.60	0.98
Roasting	1.07	1.28	2.74	3.95	0.65	1.08

Effect of cooking methods on fatty acid composition of fresh chicken meat:

Data in table (3) shows the effect of cooking methods on the relative percentages of fatty acids composition of fresh chicken white (breast) and dark (thigh) meat. Changes in fatty acid composition of lipids provide an indirect measure of susceptibility of lipids to oxidation (Keller and Kinsella, 1973). The fatty acid changes in chicken meat during cooking can be the result of some chemical factors such as oxidation, hydrolysis and polymerization (Lee and Dawson, 1973). With regard to the total saturated fatty acids, the results shown in table (3) indicated that the highest increase of their percentages were found in both roasted chicken breast and thigh meats, while the lowest increases were observed in the same samples after pressure cooking as compared to the uncooked samples. The noticed trend of total unsaturated fatty acids was found to be the reverse (compared to the saturated fatty acids) i.e., they were of lower percentage in the roasted chicken breasts and thighs meat than in the same raw samples. The decrease of the unsaturated fatty acids and the increase of the saturated fatty acids during several meat cooking treatments were reported by Shams El-Din and Ibrahim (1990). The lowest loss in total unsaturated fatty acids was found in chicken breast and thigh meat samples cooked by pressure cooking methods. The unsaturated / saturated fatty acids ratios were also calculated and are shown in table (3). All cooking treatments were found to cause a decrease in the ratios of unsaturated / saturated fatty acids of either breast or thigh samples. The chicken thigh meat samples had relatively higher ratios than chicken breast meat samples after any cooking treatment used in this study.

Effect of cooking methods on the amino acid composition of fresh chicken meat:

The effects of cooking treatments on the amino acids content of chicken meat are shown in table (4). From which, it is clear that cooking of either fresh breast or thigh meat samples caused some decrease in all of their amino acids. The chicken breast and thigh meat samples, cooked by pressure, retained the highest percentages of total essential, non-essential and total amino acids, followed in a decreasing order by boiling, microwave and roasting cooking methods. However, no significant differences were found among cooking methods on amino acids content in either chicken breast or thigh meat samples. As a result of cooking of fresh breast and thigh meat samples by pressure, the total amino acids were found to decrease from 88.95 to 84.21 and from 87.11 to 81.16 g/16 g N. respectively. Meanwhile, they decreased from 88.95 to 81.43 and from 87.11 to 77.43 g/16 g N. in the fresh breast and thigh meat samples cooked by roasting respectively. Marked amounts of sulpher containing amino acids, i.e. leucine, tyrosine, phenylalanine and lysine (as essential amino acids) as well as serine, glycine, alanine, histidine and arginine (as non-essential amino acids) were destroyed, while a slight decrease was noticed in all the other amino acid contents under cooking of chicken breast or thigh meat samples.

Table (3): Effect of cooking methods on fatty acids composition of chicken meat {% of total fatty acids}.

Fatty acids	Cooking methods									
	Uncooked		Boiling		Pressure		Microwave		Roasting	
	Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh
C12 : 0	--	--	--	--	--	--	--	tr.	--	tr.
C14 : 0	1.10	1.18	1.10	1.25	1.15	1.20	1.25	1.36	1.27	1.31
C14 : 1	0.20	0.30	0.21	0.35	0.21	0.30	0.15	0.24	0.10	0.26
C16 : 0	24.27	22.91	24.39	23.36	24.45	22.93	24.64	23.84	24.76	24.01
C16 : 1	5.83	7.21	5.49	7.00	5.45	6.80	5.37	6.71	5.29	6.59
C18 : 0	8.12	7.56	8.54	7.94	8.46	8.12	8.71	7.88	8.78	8.15
C18 : 1	42.07	40.82	42.05	40.83	41.98	40.94	42.16	41.10	42.29	41.18
C18 : 2	16.91	18.20	16.82	17.82	16.86	18.01	16.72	17.65	16.54	17.39
C18 : 3	1.10	1.30	1.00	1.10	1.09	1.20	0.90	0.94	0.87	0.90
C20 : 0	0.40	0.52	0.40	0.45	0.35	0.50	0.10	0.19	0.10	0.12
Total sat. fatty acids	33.89	32.17	34.43	33.00	34.41	32.75	34.70	33.27	34.91	33.59
Total unsat. Fatty acids	66.11	67.83	65.57	67.00	65.59	67.25	65.30	66.64	65.09	66.32
Unsat./sat. ratio	1.95	2.11	1.90	2.03	1.91	2.05	1.88	2.00	1.86	1.97

tr. = traces (< 0.10 %)

Table (4): Effect of cooking methods on the amino acid composition of fresh chicken meat:

Amino acids (g/16 g N)	Chicken white meat (breast)					Chicken dark meat (thigh)				
	Cooking methods					Cooking methods				
	Uncooked	Boiling	Pressure	Microwave	Roasting	Uncooked	Boiling	Pressure	Microwave	Roasting
Essential amino acids										
Threonine	3.09	2.92	2.95	3.01	2.93	2.80	2.65	2.61	2.56	2.44
Valine	5.87	5.51	5.53	5.42	5.24	4.62	4.36	4.35	4.17	4.01
Methionine	2.92	2.36	2.42	2.25	2.16	2.50	1.83	1.92	1.85	1.80
Isoleucine	5.01	4.85	4.91	4.86	4.80	4.79	4.59	4.73	4.51	4.35
Leucine	7.65	6.93	6.95	7.02	6.95	7.30	6.41	6.52	6.36	6.21
Tyrosine	2.48	2.21	2.27	2.11	1.98	2.55	2.14	2.10	2.03	1.95
Phenylalanine	3.59	3.24	3.26	3.15	3.11	3.44	2.97	3.02	2.95	2.83
Lysine	7.85	6.98	7.08	6.91	6.85	7.74	6.78	6.86	6.73	6.65
Tryptophane*	--	--	--	--	--	--	--	--	--	--
Total	38.46	35.00	35.42	34.73	34.02	35.74	31.73	32.11	31.16	30.24
Non-essential amino acids										
Aspartic acid	8.95	8.72	8.83	8.64	8.55	9.32	8.91	8.96	8.75	8.59
Serine	3.20	3.06	3.11	3.02	2.98	3.14	2.93	2.97	2.96	2.87
Glutamic acid	16.09	15.81	15.90	15.81	15.74	16.54	16.16	16.21	15.95	15.83
Proline*	--	--	--	--	--	--	--	--	--	--
Glysine	5.23	4.96	5.02	4.93	4.85	6.56	6.25	6.32	6.18	6.12
Alanine	5.71	5.41	5.46	5.30	5.26	6.01	5.76	5.81	5.72	5.61
Histidine	3.87	3.58	3.61	3.48	3.39	2.75	2.39	2.45	2.34	2.26
Arginine	6.32	5.90	5.93	5.81	5.77	5.70	5.18	5.23	5.10	4.94
Cysteine	1.12	0.96	0.98	0.93	0.87	1.35	1.17	1.10	1.14	0.97
Total	50.49	48.40	48.84	47.92	47.41	51.40	48.75	49.05	48.14	47.19
Total determined amino acids	88.95	83.40	84.21	82.65	81.43	87.11	80.48	81.16	79.30	77.43

*Not determined.

Similar results were previously reported by Usborn *et al.*. (1968); Taira *et al.*. (1970), Abo-Raya (1979); Moussa (1981); Moawad (1987) and Serour (1995). The amino acids composition of protein in the muscles was slightly changed after heating and the losses of amino acids were significantl at 120°C than at 100°C. The reduction of amino acids contents might be attributed to their loss with drippings separated during cooking as well as by the heat destruction (Abd El-Wahed, 1986).

Sensory evaluation of fresh chicken meat cooked by different methods :

With respect to sensory evaluation, the eating quality characteristics of the fresh cooked chicken breast and thigh meat samples by different cooking methods were assessed and the obtained results are presented in table (5). The obtained results in the same table reveal significant changes (p<0.01) on tenderness of either fresh chicken breast or thigh meat samples cooked by boiling and pressure methods compared with the same samples cooked by microwave and roasting methods. These results agree with those reported by Korschgen *et al.*. (1976). On the other hand, Petchenco and Ratoshny (1977) reported that the reduction of bound water caused a marked decrease in tenderness of cooked breast and thigh meat samples. The fresh chicken breast meat samples cooked by microwave and roasting had no significant differences (p<0.01) between them for tenderness. Wilkinson and Dawson (1967) found that the cooking temperature must be enough to overcome the high content of connective tissues in poultry meat to cause suitable tenderness. Referring to the same table (5), it could be noticed that the cooked fresh chicken breast and thigh meat samples by boiling and pressure had higher scores for juiciness as compared with the same samples cooked by microwave and roasting. These results confirmed the findings of Korschgen *et al.*. (1976) and Barbeau and Schnept (1989). The fresh chicken breast meat samples cooked by boiling and pressure showed no significant differences (p<0.01) between them for juiciness. However significant changes (p<0.01) took place for juiciness of fresh cooked chicken breast meat samples by microwave and roasting methods. Moreover, the fresh chicken breast and thigh meat samples cooked by microwave and roasting had significant differences (p<0.01) flavour as compared with the same samples cooked by boiling or pressure.

Flavour scores were associated with tenderness and juiciness in both white and dark meats regardless of the packaging variable or the cooking treatment. Panelists often commented that flavour was the most difficult factor to judge Culotta and Chen (1973). No significant changes were found of flavour of fresh chicken thigh meat samples cooked by microwave and roasting. Risch (1989) found that foods prepared by using a microwave oven usually generate less desirable flavours than those prepared by conventional ovens. Concerning palatability, it could be concluded that the fresh chicken breast and thigh meat samples, cooked by microwave and roasting, had significant changes (p<0.01) on palatability which, it could be concluded that the fresh chicken breast and thigh samples cooked by microwave and roasting had significant changes (p<0.01) on palatability as compared with the same samples cooked by boiling or pressure. Harrison (1980) pointed out that the processing conditions and cooking methods are known to affect the palatability of cooked meat and, it has been suggested that higher surface temperature in microwave cooked meat may lead to excessive protein denaturation; sensory perception of meat juiciness is related to the degree of wetness preceived as the first few chews are taken. No significant differences ($p<0.01$) were observed on palatability for fresh chicken breast and thigh meat samples cooked by any cooking method. The above mentioned results are in accordance to the findings of Shireva *et al.*. (1979).In general, the results in table (5) indicate that, fresh chicken breast and thigh meat samples cooked by boiling and pressure had significant difference ($p<0.01$) for tenderness and juiciness as compared with the same samples cooked by microwave and roasting. Meanwhile, the latter two cooking methods caused significant changes ($p<0.01$) of flavour and palatability for the same samples as compared with the boiling and pressure cooking methods.

Table (5): Statistical analysis of sensory scores (L.S.D.) of cooked chicken breast and thigh meats.

Sensory characteristics	Cooking methods								L.S.D. ($p<0.01$)
	Boiling		Pressure		Microwave		Roasting		
	B	T	B	T	B	T	B	T	
Tenderness	8.5^{a}	8.4^{a}	8.3^{ab}	8.1^{ab}	6.9^{c}	6.7^{cd}	6.9^{c}	6.8^{c}	0.56593
Juiciness	8.1^{a}	8.2^{a}	8.1^{a}	8.1^{a}	6.6^{bc}	6.5^{cd}	6.7^{b}	6.6^{c}	0.57295
Flavour	7.4^{d}	7.6^{b}	7.4^{d}	7.6^{b}	8.8^{ab}	9.0^{a}	8.9^{a}	9.0^{a}	0.46730
Palatability	7.0^{cd}	7.2^{cd}	7.1^{c}	7.4^{c}	8.6^{ab}	8.7^{ab}	8.7^{a}	8.8^{a}	0.53756

The mean scores in raw with same letter or letters are not significantly at the 1% level of significancan

Therefore, from the present data, it can be concluded that all cooking methods caused:

1. Noticeable increases in the acid, peroxide, and TBA values, especially in the case of both roasted breast or thigh meat samples.
2. A decrease in the ratios of unsaturated/ saturated fatty acids as well as total essential and non-essential amino acid was noticed.
3. Fresh chicken breast and thigh meat samples cooked by boiling and pressure showed significant differences for tenderness and juiciness as compared with the same samples cooked by microwave and roasting. Meanwhile the latter two cooking methods caused significant changes ($p<0.01$) in flavour and palatability for the same samples as compared with both boiling and pressure methods.

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تاثير طرق الطهى المختلفة على صفات لحم الدجاج

نجلاء عبد الله شديد*، سعد أحمد سعد حلابو، فتح الله عبد السلام الوكيل** و محمد حامد على شمس الدين***

*** قسم الصناعات الغذائية- المركز القومي للبحوث- الدقى- جيزة-مصر ***

****قسم الصناعات الغذائية- كلية الزراعة- جامعة القاهرة-جيزة-مصر**

احتفظت أجزاء لحم الدجاج المختبرة والمطبوخة تحت ضغط وبالغليان بنسبة أعلى من الرطوبة والليبيدات الكلية عن عينات لحم الدجاج المشوية والمطهية بالميكروويف. ومن ناحية أخرى احتفظت عينات لحم صدر وفخذ الدجاج المطهية تحت ضغط بأعلى نسبة من النيتروجين الكلى والبروتين الكلى والنيتروجين الكلى الذائب والنيتروجين البروتينى الذائب ونيتروجين الأكتوميوسين الذائب والنيتروجين غير البروتيني متبوعة بالطهي بالميكروويف ثم الشي والطهى بالغليان. بينما احتفظت العينات بأعلى نسبة من الرماد والمعادن بعد الطهي بالميكروويف عن طرق الطهى الأخرى لكل من عينات لحم فخذ وصدر الدجاج وجدت زيادة ملحوظة في الرقم الحمضى ورقم البيروكسيد ورقم حمض الثيوباربيتيوريك فى حالة الشى لكل من عينات لحم الصدر والفخذ وتبين من النتائج المتحصل عليها أن عينات لحم صدر الدجاج بعد أى طريقة من طرق الطهى لها رقم بيروكسيد ورقم حموضة وثيوباربيتيوريك أقل من عينات لحم الفخذ. كانت أعلى نسبة زيادة في الأحماض الدهنية المشبعة فى كل من عينات لحم الصدر أو الفخذ المشوية. بينما كانت أقل زيادة لنسبها بعد الطهي تحت ضغط لنفس العينات بالمقارنة بالعينات الغير مطهية. بينما كان اتجاه الأحماض الدهنية غير المشبعة عكسياً مقارنة بالأحماض الدهنية المشبعة. ولقد كان لعينات لحم فخذ الدجاج نسب أعلى من الأحماض الدهنية غير المشبعة للمشبعة عنها فى عينات لحم الصدر وبعد أى طريقة طهى. لقد احتفظت عينات لحم صدر وفخذ الدجاج المطهية تحت ضغط بنسب أعلى من الأحماض الأمينية الأساسية وغير الأساسية والكلية متبوعة بتناقص فى حالة الطهى بالغليان والميكروويف والشى، ولكن لم يلاحظ بين طرق الطهى هذه اختلافات معنوية لمحتواها من الاحماض الأمينية.