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STUDY OF THE EFFECT OF COOKING METHODS ON THE SENSORY AND CHEMICAL PROPERTIES OF FRESH AND FROZEN CHICKEN LIVER

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Abstract

Fresh and frozen chicken liver for one month was selected and samples were taken by 100 g and were cooked in three ways (boiling/frying/grilling). The sensory evaluation of the samples was carried out by specialists and the weight was taken before and after cooking to determine the weight loss. Laboratory and chemical tests were made to extract the chemical content of (protein, fat, ash, moisture and carbohydrates) and mineral elements (iron, magnesium, phosphorus and potassium). The results showed that the best way in cooking is the method of boiling because liver keeps its nutritional value after cooking and preservation of metal elements, In addition to the acceptance of the taste by the assessors, after grilled method, in addition that the fresh liver could keep food content more than the frozen ones, which lost a lot because of storage and freezing.
***Keywords*:** Chicken liver, Boiling, Frying, Grilling

Introduction

Chicken liver is a part of the chicken's bowels, has a brown color tends to reddish, with smooth texture. It has a special taste and a lot of useful substances (Hutchiso *et al*., 2015), liver is of great importance because it contains a lot of important nutrients, such as calcium, protein, carbohydrates in addition to iron, magnesium and various types of vitamins (King and Chen, 1998).

It is a very rich source of good absorption iron and important for the prevention of anemia, and vitamin B12 is important in the balance and support the production of red blood cells and prevent the incidence of malignant anemia, it equips the body with more than three times of the daily needs (Tang *et al*., 2000; Vinca and Raul, 2017). As well as zinc and selenium; it is a massive store of vitamin A, which is important for the prevention of certain diseases and for strengthening the immunity of the body. The liver contains a good proportion of B vitamins, especially folic acid which is so useful for the pregnant mother and the health of her fetus (Hanzeh *et al*., 2016). Chicken liver contains a large amount of vitamin E. This compound preserves not only the skin and hair in excellent condition; it is a powerful antioxidant and regulator of reproductive function (Meyer *et al*., 1976).

Chicken liver is ideal for weight loss because it contains low energy. Regular use helps to improve the condition of the skin and function of immunity, as well as prevent the development of anemia, which is very important for those who want to lose weight and maintain the slim form (Scapin *et al*., 1988; Fujiwara *et al*., 1989).

With all these nutritional and healthy benefits of the liver, but it's eating must be moderated with and non-extravagance because it is rich in purines, which leads to the formation of uric acid in the body, which high levels of which leads gout disease (Okamura *et al*., 1982; Beringhell *et al*., 2001), as well as it is very rich in cholesterol, which makes it an unsuitable for people with heart disease, high blood pressure and diabetes, and the liver contains a high amount of vitamin A, if surfeit in the eating, person may complain of a symptoms of hyper vitamin consumption (Beringhell *et al*., 2001; Yong and Searcy, 2001).

Materials and Methods

Fresh and frozen chicken liver for one month with 100 gm for each sample were taken. Three cooking methods were performed (boiling, frying and grilling) with 2 g salt per sample. When cooking, the weight of each sample was taken before and after the cooking process to extract the weight loss. Sensory evaluation by specialists has made, and then transferred to the laboratory for the following chemical tests.

Chemical Composition

The chemical composition of the samples was estimated by using the standard methods mentioned in AOAC (2005) as shown below.

1. Determination of protein

Determination of the protein for the sample using the Keldar method where the total nitrogen ratio is estimated and multiplied by factor 6.25 to extract the percentage of the protein.

2- Moisture Determination

3-2 g of each sample was taken after cooking with the three methods. It was placed in a jar of a known weight with an oven of 105 m until the weight was confirmed. After cooling, the jar was taken and weighed and the moisture extracted.

3. Determination of ash

A certain amount of the sample was burned in the Muffle Furnace incinerator at a temperature of 525 m until the color was changed to the white gray to extract the amount of ash in the sample.

4 - Determination of fat

Suxlate device was utilized to extract lipids using oil ether.

5- Determination of carbohydrates (calories)

The calorimeter was used to measure calories (CHO). A certain amount of the sample is burned in a closed space surrounded by a quantity of water; the energy resulted of burning of the sample raises from the temperature of the surrounding water in the combustion chamber. By knowing the amount of heated water and the amount of increasing of temperature, we can calculate the calories.

6. Energy assessment

The energy was calculated for each sample through a mathematical equation for the amount of protein, fat and carbohydrates, where protein was multiplied by 4 and carbohydrates by 4 and fat by 9 and by combining the output we obtained the amount of energy. (AOAC, 2005)

7. Determination of mineral

By using the Atomic Absorption Scectrophometer, made by the Perkin Elmer Company of 500VSA, estimated the iron, magnesium, potassium and phosphorus elements according to the method mentioned (AOAC, 2000).

8. Sensory evaluation

The sensory evaluation of the fresh and frozen cooked liver sample of the three cooking methods was conducted by 10 specialists and according to the assessment form approved by the Food and Nutrition Department of the University of Kansas (USA1975) (Griswold, 1979) using the Hedonic, Scale from 1 -7, where, 7 = excellent, 6 = very good, 5 = good, 4 =medium, 3 = acceptable, 2 = bad, and 1 = very bad for the comprehensive sensory characteristics (color, flavor, taste, smell and cutting force).

9. Statistical analysis

The Statistical Analysis System (SAS) (2012) was used to analyze the effect of different coefficients of all the studied traits in randomized design for each of (CRD) and the differences between the mean were compared with the least significant difference (LSD).

Results and Discussion

Table 1 : Amount of weight loss for samples before and after cooking

Coefficient type%	Before cooking%	After cooking%	Weight loss%
A1	100	74	**26**
A2	100	72	28
A3	100	66	34
B1	100	68	32
B2	100	70	30
B3	100	61	39

Table (1) shows the amount of weight loss for samples before and after cooking, from this we notice the difference in the amount of loss. In coefficient A the fresh liver, the highest loss was in the grilled method (A3) where the loss was 32% and in the frying method, the loss reached 28% and in boiled 26%. As for the frozen liver (B), in general it has lost more of the fresh liver because of the freezing (Hutchiso *et al*., 2015). The highest ratio in the coefficient of B3 grilled liver where it reached 39%, the reason behind the high loss in the method of grilled, backs to the loss of liquid during fire exposure, the matter that causes reducing in the weight of the sample after the completion of the cooking process (Beringhell *et al*., 2001).

Table 2 : The effects of the studied parameters on the results of the chemical composition

Average ± standard error						
Transaction	**Pr**	**FAT**	**Humidity**	**ash**	**CHO**	**energy**
A : 1	14.22 ± 0.52	7.05 ± 0.13	2.63 ± 77.9	6.13 ± 0.14	105.3 ± 4.3	541.53 ± 36.8
A1 : 2	16.61 ± 0.67	7.69 ± 0.09	3.42 ± 97.79	6.19 ± 0.11	110.46 ± 5.8	577.49 ± 27.6
A2 : 3	15.9 ± 0.57	8.14 ± 0.17	2.79 ± 74.66	6.12 ± 0.16	104.82 ± 4.9	556.02 ± 25.91
A3 : 4	14.13 ± 0.48	7.95 ± 0.12	2.62 ± 72.69	6.61 ± 0.14	101.88 ± 5.06	537.59 ± 31.1
B : 5	15.80 ± 0.62	7.30 ± 0.10	2.04 ± 79.85	5.95 ± 0.08	108.9 ± 5.73	564.5 ± 29.4
B1 : 6	15.04 ± 0.55	7.51 ± 0.09	3.07 ± 78.61	6.03 ± 0.11	107.19 ± 4.9	556.91 ± 33.9
B2 : 7	15.72 ± 0.49	8.22 ± 0.19	3.82 ± 75.61	6.23 ± 0.16	105.57 ± 5.8	556.91 ± 22.6
B3 : 8	14.35 ± 0.53	7.65 ± 0.11	3.57 ± 71.88	6.18 ± 0.14	100.06 ± 4.7	559.14 ± 28.5
LSD Values	1.894 *	1.92 NS	* 5.69	0.652 NS	12.93 NS	526.49 ± 19.35
*P<0.05						

Table (2) elucidates the chemical composition of the samples prepared by three methods of cooking (boiling, frying, grilled) as significant differences were found (P <0.0). The analysis confirmed that fresh liver contains high amount of protein content in compared with frozen liver. As showed in the table, where A sample (Fresh and uncooked) containing (17.25) g protein per 100 g. As B coefficient is (frozen and uncooked (14.22).

The contents of the liver of the two species began to decrease after exposure to the three cooking processes with significant differences. The protein content reached 14.13 g in the coefficient of A3 (freshly grilled) and 11.35 in the B3 (frozen grilled) coefficient. As for fat, it is known that the liver generally contains an appropriate amount of saturated fat, which is confirmed by (SAS, 2012) did not happen a large loss, but increased by a simple cooking method of frying for the use of fat came in coefficient A2 to (8.14) g in the coefficient B2 (8.22) g. After the content was in A (7.05) g and in the coefficient B (7.30) g. As for the ash and moisture, there was a difference in the ratio of the three cooking methods for both types. The loss of moisture in the frozen liver, especially in the grilled method, B3 coefficient, where the humidity reached 70.08. It was also observed that the carbohydrate ratio was generally higher in fresh liver after the cooking methods compared to the frozen which started to decrease (Ruegg and Dimenstein, 2018) until reached in coefficient B3 to (100.06).

It is noted that the method of grilling has lost too many of the contents, especially frozen liver due to loss of fluids and the effect of storage while the best way to cook nutritionally by keeping the chemical composition and nutritional values is the method of boiling, which retained appropriate amount of nutrients, which confirmed that the best way to cook is the method of boiling to maintain nutritional qualities.

Table 3 : The effects of studied parameters on the results of metallic elements

Transaction	Average ± standard error			Phosphorus
	Iron	Magnesium	Potassium	
A : 1	6.14 ± 0.11	1.13 ± 0.04	2.01 ± 0.05	1.45 ± 0.07
A1 : 2	5.30 ± 0.09	1.19 ± 0.06	2.09 ± 0.08	1.49 ± 0.09
A2 : 3	5.95 ± 0.11	2.01 ± 0.03	2.11 ± 0.08	1.51 ± 0.09
A3 : 4	4.70 ± 0.07	1.69 ± 0.06	2.06 ± 0.05	1.53 ± 0.12
B : 5	4.15 ± 0.08	1.73 ± 0.04	1.08 ± 0.05	1.44 ± 0.08
B1 : 6	4.22 ± 0.07	1.77 ± 0.07	2.1 ± 0.06	1.32 ± 0.06
B2 : 7	3.51 ± 0.05	1.81 ± 0.07	1.09 ± 0.08	1.39 ± 0.06
B3 : 8	4.81 ± 0.10	1.85 ± 0.07	2.23 ± 0.11	1.41 ± 0.08
LSD Values	1.855 *	0.529 *	0.633 *	0.394 NS
.(P<0.05) *				

In Table (3), the content of samples of mineral elements before and after the three methods of cooking for both types showed that there were significant differences (P <0.0). In coefficient A, the iron content was 6.14 mg and in coefficient B, iron reached 4.15 mg, for frozen liver due to freezing and storage it is known that the liver is significantly rich in iron, especially fresh (Vinca and Raul, 2017).

After the cooking process, we generally notice a difference in the level of the mineral elements of both types of liver. The iron element reached in A3 coefficient to 4.70 mg, while in B3 coefficient it was 3.51 mg. As for Magnesium it started to get higher and more concentrated in small ratio after cooking, it already been noticed that it found higher in frozen liver. As for potassium and phosphorus, there is a difference in loss and concentration with reduced content in frozen liver.

From here we note the high nutritional value of fresh liver with its mineral content even after cooking compared to frozen liver which did not retain the mineral elements, especially iron. This is confirmed by both (Albert *et al*., 2001; Hussain and Arshad, 2013; Fadwa *et al*., 2015).

Table 4 : Effect of different coefficients on sensory characteristics

Transaction	Average ± standard error				Taste
	the color	Cutting force	Flavor	Odor	
A1 : 1	6.3 ± 0.13	6.5 ± 0.12	5.2 ± 0.07	4.2 ± 0.08	5.7 ± 0.10
A2 : 2	4.2 ± 0.05	5.7 ± 0.08	5.5 ± 0.13	4.8 ± 0.06	6.2 ± 0.14
A3 : 3	6.5 ± 0.14	7.0 ± 0.15	6.5 ± 0.11	6.3 ± 0.11	7.00 ± 0.16
B1 : 4	4.3 ± 0.7	4.0 ± 0.06	4.5 ± 0.07	3.2 ± 0.07	4.7 ± 0.08
B2 : 5	3.5 ± 0.08	3.2 ± 0.04	3.6 ± 0.04	3.0 ± 0.04	4.2 ± 0.06
B3 : 6	5.7 ± 0.12	5.8 ± 0.11	6.0± 0.17	4.0 ± 0.07	5.2 ± 0.13
LSD Values	1.752 *	1.602 *	2.17 *	1.61 *	1.58 *
.(P<0.05) *					

Table (4) showed the acceptability of liver through the sensory evaluation of the samples of both types after cooking in the three ways. Generally fresh liver obtained the highest acceptance rate and with significant differences (P <0.0) in comparing with frozen liver. (6.5), cutting force (7), flavor (6.5), taste (7) and smell (6.3) followed by the method of boiling. Frozen liver generally has less acceptance in comparing with fresh ones.

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