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# NUTRITIONAL VALUE AND ORGANOLEPTIC CHARACTERISTICS OF SOME IMPORTED CANNED TUNA SOLD IN ASSIUT GOVERNORATE

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**Received:** 20 December 2021; **Accepted:** 15 January 2022

## ABSTRACT

The current research was conducted to evaluate chemically and organoleptically some imported canned tuna sold in local supermarkets in Assiut governorate. The number of collected samples randomly was 90 canned tuna. The organoleptic assessment was done using 9- point hedonic scale ranging from dislike extremely (1) to like extremely (9). Proximate composition analysis was carried out for drained samples of canned tuna to determine moisture, crude protein, crude lipid and ash following the methodologies of the Association of Official Analytical Chemists. The results revealed that canned tuna samples contained high percentage of crude protein that ranged from 22.50% to 28.10%, with a mean value of 25.23±0.14. The moisture percentage of the examined samples varied from 61.35% to 73.55%, with a mean value of 66.24±0.26%, while total fat values varied from 0.86% to 16.68%, with a mean value of 7.32±0.40%. Ash percentage of the examined samples ranged from 0.33% to 3.18%, with a mean value of 1.47±0.07%. While total cholesterol content values of the examined samples varied from 34.62 to 51.48, with a mean value of 39.61±0.40 mg/100gm. Total carbohydrate content, caloric value, calcium content, phosphorus content, free fatty acids content (%) and fatty acid composition (%) of canned tuna samples were detected in all examined samples. From the obtained results, it is evident that all the examined canned tuna were accepted organoleptically and were considered safe for human consumption.

***Keywords:*** Canned tuna, Sensory evaluation, Chemical analysis and Food safety.

## INTRODUCTION

Tuna is very rich in high-quality protein. Tuna flesh contains considerable quantities of vitamins A, $B_{12}$, and D. It is also an actual rich source of phosphorus and iodine (Khedkar and Chavan, 2003).

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Canned fish are good sources of nutrients and minerals which must be comprised in the human diet (Odiko and Obirenfoju, 2017). Seafood is considered to be low in both total fat and saturated fat (NMFS, 2020). Most fish contain small to moderate amounts of minerals as phosphorus and potassium (NMFS, 2020). Actual daily nutrient requirements for tuna might be differed based on age, gender, level of physical activity, and other factors (USDA, 2020). High cholesterol content in food is a leading risk factor for human cardiovascular illness such as coronary

heart disease and stroke (Hongbao, 2004). Chilled or frozen tuna can provide a considerable bone health benefit to consumers by providing as much as 400 mg/100 g of available calcium in the finished product. Typically, tuna product, particularly canned tuna, contains only meat without bone. This causes the low calcium content per can of the products (PCT, 2017).

Phosphorus is an important part of our body's fats, proteins, and cell membrane. Phosphorus is highly absorbable and is found in foods as Albacore canned tuna (Inker *et al.,* 2014). Nutritionally, canned tuna were higher in nutritional value (unsaturated fatty acids/saturated fatty acids) than canned mackerel. Therefore, these canned fish could be considered safe for human health and nutrition (ElShehawy and Farag, 2019). Seafood contains an exceptional kind of polyunsaturated fat, called omega-3 fatty acids, which can provide health benefits (NMFS, 2020). The sensory examination is the assessment of all the qualities of a food article as perceived by the human sense. It is not sufficient to describe taste of food, but describing food colour, texture, flavour, and aroma should be included (Murano, 2003).

## MATERIALS AND METHODS

### 1- Collection of Samples:

A total of 90 samples from canned tuna of all commercial brands. Three types (solid, chunks and crumbled) from each brand (30 each) were randomly collected from different supermarkets in Assiut governorate. At the laboratory, part of each sample was used for sensory examination. The other part was cut separately into small pieces and was mixed well in a mortar for chemical analysis.

### 2- Laboratory analysis:

### 2.1. Organoleptic assessment:

Organoleptic assessment was done by three members of the Food Hygiene Department, Faculty of Veterinary Medicine, Assiut University. They were asked to assess appearance, colour, odour, taste, consistency and overall acceptability using 9- point hedonic scale ranging from dislike extremely (1) to like extremely (9) according to (Svensson, 2012).

### 2.2. Chemical analysis:

Proximate composition analysis was carried out for drained samples of canned tuna to determine moisture, crude protein, crude lipid and ash following the methodologies of Association of Official Analytical Chemists, AOAC (2016). In brief, moisture content was determined by drying samples in an oven at 65°C for 24 hrs then at 105°C for 6 hrs. until constant weight. Determination of crude protein was done by the Macro-kjeldal method in which 0.5 gm of the dried sample was placed in the kjeldal digestion flask with 8 gm of a catalyst mixture (96% anhydrous sodium sulphate, 3.5% copper sulphate and 0.5% selenium dioxide) and 25 ml of concentrated sulphuric acid. The clear cooled digested mixture was dissolved in 200 ml tap water then transferred to the distilling flask. Then 75 ml of 50% sodium hydroxide (50% NaOH) were added to the distilling flask .Then the liquid was titrated against N/10 sodium hydroxide solution until the end point (colourless or faint blue colour). Crude lipid was determined by Soxhlet extraction unit using Petroleum ether. Determination of ash was done by dry ashing at 550-600°C for 6 hrs. in a muffle furnace and the mass was incinerated at after the furnace has reached the required temperature (white ash was formed). The total carbohydrate was represented by the figure obtained when the sum of moisture, crude protein, fat and ash of the sample was subtracted from 100 on wet weight basis. The energy value of meat products was calculated according to the equation given by Merrill and Watt (1973). Estimation of calcium and phosphorus levels in canned tuna according to (ISO, 1996) and (ISO, 1998). Determination of

cholesterol content as extraction of fat content (Bligh and Dyer, 1959), preparation of extracted fat (Naeemi *et al.,* 1995) and enzymatic determination of cholesterol content according to Pasin *et al.* (1998). Determination of Free Fatty Acids (FFA) as lipid extraction using Folch method (Folch *et al.,* 1957) and titration procedure (Brake and Fennema, 1999). Statistical analysis were performed using excel and SPSS version 19.

## RESULTS

**Table 1**: Sensory evaluation of the examined canned tuna samples (n= 30 each).
**9 points hedonic scale** was used for sensory evaluation where 4= Dislike slightly, 5= Neither like nor dislike, 6= Like slightly, 7= Like moderately, 8= Like very much, and 9= Like extremely.

| Sensory score | Canned tuna samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Chunks tuna | | Solid tuna | | Crumbled tuna | | Total | |
| | No. Positive | % | No. Positive | % | No. Positive | % | No. Positive | % |
| 4 | - | - | - | - | 2 | 6.67 | 2 | 2.22 |
| 5 | - | - | 1 | 3.33 | 5 | 16.67 | 6 | 6.67 |
| 6 | 6 | 20 | 2 | 6.67 | 14 | 46.67 | 22 | 24.45 |
| 7 | 9 | 30 | 2 | 6.67 | 8 | 26.66 | 19 | 21.11 |
| 8 | 14 | 46.67 | 14 | 46.67 | 1 | 3.33 | 29 | 32.22 |
| 9 | 1 | 3.33 | 11 | 36.66 | - | - | 12 | 13.33 |

**Table 2:** Statistical values of moisture content of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Moisture content (%) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| **Chunks tuna** | 62.35 | 72.70 | 66.42[a] | 0.41 |
| **Solid tuna** | 62.45 | 69.65 | 66.19[a] | 0.29 |
| **Crumbled tuna** | 61.35 | 73.55 | 66.12[a] | 0.62 |
| **Total** | 61.35 | 73.55 | 66.24 | 0.26 |

**Table 3:** Statistical values of protein content of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Protein content (%) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| **Chunks tuna** | 24.20 | 26.50 | 25.29[b] | 0.14 |
| **Solid tuna** | 24.90 | 28.10 | 26.40[a] | 0.18 |
| **Crumbled tuna** | 22.50 | 25.40 | 24.00[c] | 0.16 |
| **Total** | 22.50 | 28.10 | 25.23 | 0.14 |

**Table 4:** Statistical values of fat content of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Fat content (%) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 0.86 | 12.41 | 5.97[b] | 0.47 |
| Solid tuna | 1.58 | 7.98 | 5.09[b] | 0.29 |
| Crumbled tuna | 2.91 | 16.68 | 10.91[a] | 0.70 |
| Total | 0.86 | 16.68 | 7.32 | 0.40 |

**Table 5:** Statistical values of ash content of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Ash content (%) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 0.67 | 3.01 | 1.57[a] | 0.09 |
| Solid tuna | 0.33 | 3.18 | 1.59[a] | 0.13 |
| Crumbled tuna | 0.36 | 2.58 | 1.25[b] | 0.11 |
| Total | 0.33 | 3.18 | 1.47 | 0.07 |

**Table 6**: Statistical values of carbohydrate content of the examined canned tuna samples (n = 30 each).

| Canned tuna samples | Carbohydrate content (%) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 0.38 | 5.01 | 2.15[a] | 0.23 |
| Solid tuna | 0.06 | 5.07 | 2.66[a] | 0.31 |
| Crumbled tuna | 0.01 | 4.98 | 2.53[a] | 0.28 |
| Total | 0.01 | 5.07 | 2.44 | 0.16 |

**Table 7**: Statistical values of calculated gross energy (kcal/100gm) of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Energy values (kcal/100gm) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 112.41 | 213.91 | 163.55[b] | 4.11 |
| Solid tuna | 126.86 | 196.83 | 162.00[b] | 3.33 |
| Crumbled tuna | 134.31 | 250.63 | 204.28[a] | 6.32 |
| Total | 112.41 | 250.63 | 176.61 | 3.42 |

**Table 8:** Statistical values of cholesterol content (mg/100gm) of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Cholesterol content (mg/100gm) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 35.08 | 46.92 | 39.91[a] | 0.62 |
| Solid tuna | 34.62 | 51.48 | 38.82[a] | 0.74 |
| Crumbled tuna | 34.62 | 49.20 | 40.09[a] | 0.71 |
| Total | 34.62 | 51.48 | 39.61 | 0.40 |

**Table 9**: Statistical values of calcium content (mg/100gm) of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Calcium content (mg/100gm) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 10.62 | 303.32 | 129.17[a] | 15.77 |
| Solid tuna | 5.03 | 342.72 | 123.40[a] | 20.44 |
| Crumbled tuna | 12.52 | 304.28 | 121.18[a] | 15.83 |
| Total | 5.03 | 342.72 | 124.59 | 9.99 |

**Table 10:** Statistical values of phosphorus content (mg/100gm) of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Phosphorus content (mg/100gm) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 126.73 | 765.50 | 358.21[a] | 27.29 |
| Solid tuna | 81.59 | 415.69 | 240.37[b] | 14.62 |
| Crumbled tuna | 61.96 | 222.81 | 113.19[c] | 7.61 |
| Total | 61.96 | 765.50 | 237.26 | 14.93 |

**Table 11**: Statistical values of free fatty acids content (mg/100gm) of the examined canned tuna samples (n= 30 each).

| Canned tuna samples | Free fatty acids content (%) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | ±SE |
| Chunks tuna | 2.20 | 3.17 | 2.68[b] | 0.05 |
| Solid tuna | 1.83 | 2.45 | 2.12[c] | 0.03 |
| Crumbled tuna | 2.59 | 3.63 | 3.05[a] | 0.05 |
| Total | 1.83 | 3.63 | 2.62 | 0.05 |

In the same column means with different superscripts are significantly different ($p < 0.05$).

## DISCUSSION

**1- Organoleptic quality of canned tuna:**

From the summarized results given in Table (1) it is evident that all the examined canned tuna were accepted organoleptically using 9 point hedonic scale. The degree of acceptability varied from score 6 (like slightly) in 6 samples (20%) of chunks tuna, 2 samples (6.67%) of solid tuna, 14 samples (46.67%) of crumbled tuna. Score 7 (like moderately) in 9 (30%), 2 (6.67%), and 8 (26.66%) of the chunks tuna, solid tuna, and crumbled tuna samples, respectively. Score 8 (like very much), where it was encountered in 14 (46.67%), 14 (46.67%), and 1 (3.33%) of the chunks tuna, solid tuna, and crumbled tuna samples, respectively. On the other hand score 9 (like extremely) was encountered in 1 (3.33%) and 11 (36.66%) of the chunks tuna and solid tuna, respectively.

Many investigators recorded various degrees of acceptability for the examined canned tuna samples as Caponio *et al.* (2010) and Singh-Ackbarali and Maharaj (2014). While Bahurmiz *et al.* (2018) found that sensory evaluation showed irrespective of the significant differences ($P< 0.05$) showed among the three brands of canned tuna, all values for overall means and individual attributes were greater than score 4. ElShehawy and Farag (2019) carried out sensory evaluation of all collected canned fish samples and showed that all samples were acceptable, and considered safe for human consumption. So, these results were compatible with our obtained results.

## 2- Chemical quality of canned tuna samples:

### 2.1. Moisture content:

Regarding moisture content of the examined canned tuna samples, the results in Table (2) showed that the values in chunks tuna samples were at the range of 62.35 to 72.70% with a mean value of 66.42± 0.41, while in solid tuna samples were at the range of 62.45 to 69.65% with a mean value of 66.19± 0.29. In case of crumbled tuna samples, the range from 61.35 to 73.55% with mean values of 66.12± 0.62 was recorded. The obtained results for moisture content in solid tuna samples were at the range of 62.45 to 69.65% with a mean value of 66.19± 0.29, which seemed to be lower than those registered by Khedkar and Chavan (2003) their studies of tuna have shown that Katsuwonus pelamis muscle consists of 69–72.6% moisture. While Bilgin and Genccelep (2015) revealed that mean values of canned solid and chunk tuna for moisture were 68.72±7.00, 66.86±5.90. The previously obtained results were higher than those recorded by Odiko and Obirenfoju (2017), Bahurmiz *et al.* (2018).

### 2.2. Protein content:

It is evident from the results outlined in Table (3) that the protein content of the examined chunks tuna samples varied from 24.20 to 26.50% with a mean value of 25.29± 0.14. However in solid tuna samples protein content was within the range of 24.90 to 28.10% with a mean value of 26.40± 0.18. Besides, the mean value of protein content of the examined crumbled tuna samples was 24.00±0.16 where the minimum value was 22.50%, while the maximum value was 25.40%. Similar results obtained for protein were found by Roe *et al.* (2013), Mahaliyana *et al.* (2015). The recoded results were higher than those detected by Manthey-Karl *et al.* (2014) but lower than that recorded by ElShehawy and Farag (2019) who analyzed canned tuna1 and found crude protein was 76.02 while for canned tuna 2 was 68.12.

### 2.3. Fat Content:

The total results cited in Table (4) showed that the minimum, maximum and mean fat content (%) values of examined chunks tuna, solid tuna, and crumbled tuna samples were 0.86, 12.41 and 5.97± 0.47; 1.58, 7.98 and 5.09± 0.29; and 2.91, 16.68 and 10.91± 0.70, respectively. While total values of the examined samples varied from 0.86% to 16.68%, with mean value of 7.32±0.40. Lower results obtained for fat content were found by Khedkar and Chavan (2003) found lipid 1.6–2.6%, and lipid content of up to 4.1% has been reported for some temperate species. Nearly similar value detected by USDA (2011) reported that the percentage of fat for tuna canned in oil was 8.21%. Aberoumand (2012) recorded higher fat % in canned tuna samples (21.4%). As well, higher fat % was also detected by ElShehawy and Farag (2019) in a variety of canned tuna samples. Mahaliyana *et al.* (2015) found lower fat % in canned tuna samples than our results.

### 2.4. Ash content:

Table (5) revealed that, the ash content of chunks tuna and solid tuna samples varied from 0.67 to 3.01% and from 0.33 to 3.18% with mean values of 1.57±0.09 and 1.59±0.13, respectively. For crumbled tuna samples, the mean ash value was 1.25±0.11, with minimum value of 0.36% and maximum value of 2.58%, respectively. The obtained ash content for canned tuna samples were similar to that detected by Bahurmiz *et al.* (2018), Mahaliyana *et al.* (2015). Our results were higher than that detected by Odiko and Obirenfoju (2017), but results of ash content were lower than values reported by ElShehawy and Farag (2019).

### 2.5. Carbohydrate content:

Data cited in Table (6) revealed that the mean value for the examined chunks tuna samples was 2.15± 0.23, where the minimum and maximum values were 0.38 and 5.01%, respectively. As for solid tuna samples the previously mentioned values were 2.66± 0.31, 0.06 and 5.07%,

respectively. Regarding crumbled tuna samples, the mean value was 2.53± 0.28. The minimum and maximum values were 0.01 and 4.98%. The results summarized in Table (6) were higher than those obtained by USDA (2020), but lower than that found by Odiko and Obirenfoju (2017) who found the mean as 19.82±8.76% in canned tuna samples.

**2.6. Caloric value of canned tuna samples:**

The obtained results in Table (7) showed that the energy value (Kcal/100gm) of chunks tuna, solid tuna and crumbled tuna samples ranged from 112.41 to 213.91, 126.86 to 196.83 and from 134.31 to 250.63, with mean values of 163.55 ± 4.11, 162.00 ± 3.33 and 204.28 ± 6.32, respectively. The obtained energy value for canned tuna samples were similar to that detected by Roe *et al.* (2013). The recorded results of energy value for canned tuna samples were higher than that detected by Aberoumand (2012). Our results were lower than the values recorded by Aberoumand (2011).

**2.7. Cholesterol content of canned tuna samples:**

The results achieved in Table (8) declared that the mean values of cholesterol content (mg/100gm) of the examined chunks tuna and solid tuna samples were 39.91± 0.62 and 38.82± 0.74, where the values varied from 35.08 to 46.92 and from 34.62 to 51.48, respectively. On the other hand the cholesterol mean value of the examined crumbled tuna samples was 40.09± 0.71 mg/100gm. The minimum and maximum values were 34.62 and 49.20, respectively. The results in Table (8) were lower than those obtained by Manthey-Karl *et al.* (2014). However, similar cholesterol levels were noted by Roe *et al.* (2013) and USDA (2020) in a variety of canned tuna samples.

**2.8. Calcium content of canned tuna samples:**

Results present in Table (9), it is evident that the Ca content (mg/100gm) of chunks tuna and solid tuna samples varied from 10.62 to 303.32 and from 5.03 to 342.72 with mean values of 129.17±15.77 and 123.40±20.44, respectively. For crumbled tuna samples the mean calcium value was 121.18±15.83, with minimum value of 12.52 and maximum value of 304.28, respectively. The obtained Ca values of the examined canned tuna samples were similar to that detected by Mumthaz *et al.* (2010), and USDA (2020). The results were higher than those obtained by El-Sadaawy *et al.* (2011) who found that Ca content was 22.437 ± 3.24 mg/g for tuna samples. Typically, tuna product, especially canned tuna, contains only meat without bone. This causes the low calcium content per can of the products. Tuna bone was preferred source of natural calcium used for the addition or enrichment in the seafood products (PCT, 2017).

**2.9. Phosphorus content of canned tuna samples:**

Table (10) declared that the mean values of phosphorus content (mg/100gm) of the examined chunks tuna and solid tuna samples were 358.21±27.29 and 240.37±14.62, where the values varied from 126.73 to 765.50 and from 81.59 to 415.69, respectively. On the other hand the phosphorus content mean value of the examined crumbled tuna samples was 113.19±7.61. The minimum and maximum values were 61.96 and 222.81, respectively. The obtained phosphorus content for examined canned tuna samples was similar to that found by USDA (2020). The results were higher than those obtained by Odiko and Obirenfoju (2017). NMH (2018) stated that high Phosphorus foods have more than 100 mg phosphorus per serving. Tuna contain high phosphorus content as 120 mg, so our results seemed to be higher than this result.

**2.10. Free fatty acids content (%) of canned tuna samples:**

Data cited in Table (11) revealed that the mean value for the examined chunks tuna samples was 2.68±0.05, where the minimum and maximum values were 2.20

and 3.17%, respectively. As for solid tuna samples the previously mentioned values were 2.12± 0.03, 1.83 and 2.45%, respectively. Regarding crumbled tuna samples, the mean value was 3.05± 0.05. The minimum and maximum values were 2.59 and 3.63%. Mahaliyana *et al.* (2015) recorded similar results for free fatty acids content for a variety of canned tuna samples. Our results were lower than obtained by ElShehawy and Farag (2019) who found that polyunsaturated fatty acids percentage 69.4%, of which linoleic acid recorded 66.3% in canned tuna, while our results were higher in saturated fatty acids and monounsaturated fatty acids (as they found the content were 16.9 and 11.4, respectively). SHIM *et al.* (2004) recorded higher results for free fatty acids content than our results for a variety of canned tuna samples.

## CONCLUSION

Chunks tuna showed the highest mean values of moisture content, while solid tuna showed the highest mean values of protein, ash and carbohydrate. Crumbled tuna was the highest in pH, fat, energy and cholesterol. On the other hand, the lowest mean values for energy and cholesterol were detected in solid tuna, while, the lowest mean values for moisture, protein and ash were observed in crumbled tuna samples. As well, solid tuna showed the lowest mean values of pH and fat content; meanwhile, chunks tuna showed the lowest mean values of carbohydrate percentage. The mean values of chunks tuna, solid tuna and crumbled tuna samples with different superscripts in the same column are significantly different ($p < 0.05$).

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## القيمة الغذائية والخصائص الحسية لبعض أنواع التونة المعلبة المستوردة المباعة في محافظة أسيوط

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الهدف من البحث هو إجراء تقييم كيميائي وحسي لبعض التونة المعلبة المستوردة التي تباع في محلات السوبر ماركت المحلية في محافظة أسيوط حيث تم تجميع عدد 90 عينة لإجراء البحث. أظهرت النتائج احتواء عينات التونة المعلبة على نسبة عالية من البروتين الخام تراوحت بين 22.50٪ إلى 28.10٪ بمتوسط قيمة 25.23 ± 0.14 (DW). تراوحت نسبة الرطوبة في العينات المفحوصة من 61.35٪ إلى 73.55٪ بمتوسط قيمة 66.24 ± 0.26 ، بينما تراوحت قيم الدهون الكلية من 0.86٪ إلى 16.68٪ بمتوسط قيمة 7.32 ± 0.40. إختلفت نسبة الرماد في العينات المفحوصة من 0.33٪ إلى 3.18٪ بمتوسط قيمة 1.47 ± 0.07. بينما تراوحت القيم الإجمالية لمحتوى الكوليسترول في العينات التي تم فحصها من 34.62 إلى 51.48 بمتوسط قيمة 39.61 ± 0.40. وتم الكشف عن المحتوى الكلي للكربوهيدرات ومحتوي الطاقة ومحتوى الكالسيوم ومحتوى الفوسفور ومحتوى الأحماض الدهنية الحرة (٪) وتحديد تركيبة الأحماض الدهنية (٪) لعينات التونة المعلبة في جميع العينات. وقد خلصت نتائج هذه الدراسة أن جميع عينات التونة المعلبة كانت مقبولة حسيًا وذات قيمة غذائية مرتفعة وصالحة للاستهلاك الأدمي.