تقدير المكونات البيوكيميائية للسماك المجفف (وزف) في اليمن

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المستخلص. يُحضّر السمك المجفف المسمى محليا (الوزف) بطريقة تقليدية في بعض المناطق الساحلية لليمن. في هذه الدراسة تم تقدير التركيب البيوكيميائي (الرطوبة، والبروتين، والدهون، والكربوهيدرات، والرماد) للسمك المجفف المتوفر في الأسواق اليمنية. تقدير مستوى الأس الهيدروجيني كان أيضا ضمن الدراسة. جُمعت العينات من العديد من محلات البهارات في ثلاث مدن يمنية، هي: صنعاء، وتعز، والحديدة. أظهرت النتائج أن نسبة الرطوبة في العينات كانت تتراوح بين ٤,٠٦ و ١٢,٨٠٪، بينما تراوحت نسبة البروتين بين ٣٢,٦٣ و ٥٥,٩٢٪، حيث شكلت أعلى نسبة بين المكونات المقدرة. كانت نسبة الدهون مرتفعة تراوحت بين ٣٠,٨٦ و ٣٨,٧٣٪. تغيرت نسبة الرماد من ١٣,٤٧ إلى ٢٢,٢٥٪، بينما شكلت الكربوهيدرات أقل نسبة بين المكونات المقدرة، حيث قدرت قيمتها بين ٣,٢٠ و ٣,٧٤٪. تأرجحت قيمة الأس الهيدروجيني للعينات في مدى ضيق بين ٦,٠٣ و ٦,٢٠. القيم المرضية للبروتين، والدهون والرماد يمكن أن تسلط الضوء على هذا السمك كمصدر غذائي جيد بين الأغذية المحفوظة. ليس هناك اختلافات معنوية بين نتائج العينات المختلفة على أساس المناطق التي جمعت منها العينات.

الكلمات المفتاحية: وزف، سمك مجفف، رطوبة، بروتين، دهون، رماد، اليمن.

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Table 2. Difference among means in different group of sundried fish (Wazef).

Group	N	Mean	Std. Deviation	95% Confidence Interval for Mean		F	Sig.
				Lower Bound	Upper Bound		
Taiz	24	16.9200	14.22639	10.9127	22.9273		
Sana'a	12	19.3208	16.91878	8.5712	30.0705	0.126	0.882
Hodeidah	18	18.6533	14.69669	11.3448	25.9618		
Total	54	18.0313	14.75083	14.0051	22.0575		

The mean difference is significant at the 0.05 level.

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India, and this was very close to the present result. Dried fish having pH level in the range of 6.0 – 6.9 are considered to be of very good quality (FAO, 1981). This lead to state that the result of the present study was within the acceptable pH range of good quality.

The results of the statistical analysis (Table2) showed that there is no significant difference ($P>0.05$) between the means of constituents estimated in the present study based on the location of collection.

4. Conclusion

The results of this investigation indicated that the selected dried fish have a good amount of nutrients at acceptable level of pH. The results revealed the proper drying practices indicated from the moisture percentage.

Satisfactory amount of protein and high contents of lipids give this fish its significance as healthy food. High percentage of ash makes it considered as a good source of minerals. This supports the marketing of dried fish and traditional food products market. Fish drying practices should be improved in order to increase the nutritional value of the products and to prevent contamination.

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Fig. 1. Samples of sundried fish (wazef), (right) Anchovy and (left) Sardine.

Table 1. Proximate biochemical composition and pH level of sundried fish (Wazef).

Sample No.	Moisture % (Dry weight)	Protein % (Dry weight)	Lipids % (Dry weight)	Carbohydrate% (Dry weight)	Ash % (Dry weight)	pH
1	6.47	46.13	30.86	3.32	14.14	6.04
2	4.53	32.6	34.31	3.25	13.47	6.2
3	4.06	33.9	35.61	3.64	16.27	6.1
4	4.98	36.2	32.33	3.56	22.06	6.05
5	12.46	41.8	32.76	3.35	20.87	5.15
6	4.2	36	32.32	3.74	16.95	6.08
7	12.8	55.9	35	3.54	19.18	6.14
8	6.46	32.9	38.73	3.2	22.25	6.03
9	4.08	40.7	33.23	3.52	22.22	6.05
Mean±SD	6.67±3.50	39.57±7.63	33.91±2.33	3.46±0.19	18.60±3.50	5.98±0.32

Values representing triplicate readings.

selected dried fish species. Mansur *et al.* (2013) reported a range of protein content from 49.23% to 62.85% in three selected dried fish. Islam *et al.* (2013), Ullah *et al.* (2016) and Hazarika *et al.* (2016) were also found very close results varied in the range of 32.02% to 41.38%, 27.46% to 56.65% and 28.63% to 53.84%, respectively.

High values of lipids in the present study were in the range of 30.86 % to 38.73%. Several workers observed wide range in the lipid content. For example: Azam *et al.* (2003) found a huge variation in the lipid content which ranged from 97.7% to 26.13%. Present results are differed from the values reported by Ochieng *et al.* (2015) and Abraha *et al.* (2017) in other sardine and anchovy. Islam *et al.* (2013), Kumar *et al.* (2013) and Geetha *et al.* (2014) recorded lower quantities of 3.21% to 14.03%, 2.2% and 0.65% to 0.4%, respectively. Which differs significantly from the present study. Different results may occur because of using different fish species and their food ground. High value of lipids may indicate the acidic condition and that will be clear when compared to pH level of samples.

Ash content is the measure of the total amount of minerals present in the food. It reflects the importance of the species as a source of minerals. As can be seen in table1, this dried fish is containing an amount of ash ranging from 13.47% to 22.25%. This fish is dry as whole, and this fact could explain the high content of ash. This elucidation was in corresponding with the statement of Thilsted *et al.* (1997) who said that small fishes are eaten whole with their organs and bones, and contain large amount of minerals mainly Ca, Fe and Zn. Traditional drying of fishes is often done in the open field on the sand. As a result, there are chances of contamination with sand and other particles, which ultimately increase ash content. These could be the acceptable elucidation of high ash content in the present

study. The results were consonant with findings of Ochieng *et al.* (2015), but not with that of Abraha *et al.* (2017) in sardine and anchovy.

Flowra *et al.* (2012), Islam *et al.* (2013), Ullah *et al.* (2016) and Hazarika *et al.* (2016) also obtained similar results, their results of ash content were 9.63% - 22.73%, 20.14% - 24.40%, 11.177% - 29.197% and 8.96% - 30.30%, respectively. Less amount were recorded to be 4.68% to 6.72% by Siddique *et al.* (2012). Variation was noticed in ash content in different studies, and this variation could have been due to variation in age, sex and environment (Huss, 1995). It may also reflects the species, season and location (Azam *et al.*, 2004).

Carbohydrate in fishes known to be in small quantities. The carbohydrate content obtained was in the range of (3.20% - 3.74%). Siddique *et al.* (2012) obtained similar result varied from 0% to 3.71% in three dried marine fishes. Several investigators namely, Omotosho *et al.* (2011), Dewi *et al.* (2011) and Ravichandran *et al.* (2012) have recorded higher results with different amounts. While Islam *et al.* (2013) found less than 1% carbohydrate ranged between 0.17% to 0.64%. According to Srivastava (1999) carbohydrate does not occur in fish except glycogen in liver. In the present investigation the amount of carbohydrates were found may related to the inner organs such as liver because the whole bodies of the specimens were used.

Knowledge on the pH level of fish meat may give valuable information about its condition. The pH of dried fish samples in the present study was ranged from 6.03 to 6.2. Close results were obtained by other workers, which found the main pH value varied between 6.23 and 8.33 by Ullah *et al.* (2016). Kakati *et al.* (2017) obtained a range of 6.2 to 6.6, in six dried fish products from Assam,

Carbohydrate: The total carbohydrate content of the fish was estimated by anthrone reagent (Sadassivam and Manickam, 1992). The results were expressed as percentage.

Determination of pH: One gram sample was homogenized in 10ml of distilled water and the mixture was filtered. The pH of the filtrate was measured using a pH meter.

Statistical analysis: The mean $\pm$ SD for each sample was calculated. Based on the location from where the samples were collected (Taiz, Sana'a and Hodeidah), the results were divided into 3 groups. Group Taiz including sample 1-4, group Sana'a (samples 5-6) and group Hodeidah (samples 7-9) and the one-way ANOVA analysis of variance was carried out using statistical package (SPSS 23) to compare the results among the 3 groups.

3. Results and Discussion

As stated by Jacquot (1961), the main chemical constituents in fresh fishes are water (66-84%), protein (15-24%), lipids (0.1-22%), minerals (0.8-2%) and about 0.3% of carbohydrates. However, these values would be changed when fish subject to drying process. Haque (2004) reported that, normally the sun-dried fish contains an average of 10% - 20% moisture and 60% - 80% protein. In the present investigation, the values of the proximate composition and pH level are presented in Table 1. The results of statistical analysis are shown in Table 2.

The moisture of living systems contributes as much to the essential properties of life. Lose of water from tissues affects the quality of tissue particularly the texture of the processed products. The highest moisture content was found to be 12.80%, and the lowest was 4.06%. Other investigators recorded more or less similar results in different species of the families Engraulidae and Clupeidae. Immaculate *et al.* (2012) found a range of 4.0% to 11.60% in sun-dried

Sardinella fimbriata. Ochieng *et al.* (2015) reported chemical and nutritional quality of dried sardine *Spratellomorpha bialalis* with a main 16.60% moisture content. According to Abraha *et al.* (2017), the main of moisture content was 7.7% in sun-dried Anchovy *Stelophorus heterolobus*. Results of present study were also close to the results found by several authors in other fishes. According to Kumar *et al.* (2013), the moisture content was ranged from 6.42% to 4.93%. The results were also in agreement with the results reported by Ullah *et al.* (2016). Other workers were recorded more or less different results such as Flowera *et al.* (2012) and Ben Smida *et al.* (2014). The results of the present investigation were less than the normally stated range of Haque (2004); however, they remain close to it. This lower percentage may give an indication to proper drying processes and good storage facilities in the present study.

Higher percentage of protein is desirable, as it being an important factor for food quality assessment. Among the studied samples of dried fishes, protein content varied between 32.6% and 55.9%. Although, the protein was found in a good percent, the values were not in the range reported by Haque (2004). Extended period of drying time can be a reason for protein destruction (Ariyawans, 2000). Method of processing could be considered as a reason, too. Comparing with the studies on sardine and anchovy fish, the result was agree with that of Ochieng *et al.* (2015) which found a main of 56.82 kg/100kg in sardine *Spratellomorpha bialalis*. However, they did not agree with the main value of 75.32%, which reported by Abraha *et al.* (2017) in anchovy *Stolephorus heterolobus*. The present results are more or less in agreement with other investigator results such as those of Azam *et al.* (2003) which found a range of protein oscillated between 40.69 and 66.52% in fourteen

on biochemical composition of dried fish species and changes occurred during dehydration is scanty (Raghunath *et al.*, 2000). Thus, there is still a need to perform more research work in this field.

Dried fishes have been used for centuries in Yemen. Yemeni people in many areas are consuming dried fish, as stable food particularly in poor and rural communities. The fish locally named “wazef” is the most edible dried fish in Yemen. Information on the proximate biochemical composition and nutritional value of fresh as well as dried fishes are very poor in Yemen. Hence, the present investigation was carried out in order to evaluate the percentage of proximate biochemical composition of traditionally dried fish “wazef” for its importance. This work could be the first study on this type of fishes in Yemen, whereas there is lack of information in this field.

2. Materials and Methods

Samples of dried fish were collected from local condiment shops in three cities (Taiz, Sana'a and Hodeidah), Yemen. Samples were arranged from one to nine. Because of the small size of individual fish, each sample was containing a large number of small fishes. Small fishes used to be collected by fishermen, spread on the sandy beach for drying under sunlight. Collected samples were brought to the laboratory in airtight polythene bags for the analysis of proximate composition and pH level. All the analysis were performed in the laboratories of Faculty of Sciences, Sana'a University. The experiments were conducted during the period from June to December 2016.

It is worth to be mentioned that there was no information available on this fish and its scientific name, a trail was made to identify it according to Whitehead *et al.* (1985&1988). Accordingly, wazef could be classified to the

family level. Further classification taxa below the family rank were not clear because of losing many morphological characteristics that would be used in the classification, due to simple traditional drying method and storage. Depending on this trail wazef is containing members of two families Achovy (Engraulidae) and Sardine (Clupeidae). Samples are shown in Fig. 1.

Biochemical analysis such as (moisture content, protein content, lipid content, ash content, carbohydrate content) and pH level were analyzed according to standard Association of Official Analytical Chemists (AOAC, 1980) methods in triplicate.

Moisture content: Five grams of dried fish sample were taken and kept at 105° C in a hot air oven until a constant weight was obtained. Moisture content Percentage was calculated and expressed as percentage by the following formula:

$$\text{Moisture \%} = \frac{(\text{weight of tissue} - \text{dry weight of tissue}) \times 100}{\text{Weight of tissue}}$$

Protein content: Protein content was determined by Lowry's method (Lowry *et al.*, 1951) with slight modification and results were expressed in percentage.

Lipid content: Crude lipid content was estimated by Soxhlet method and the amount of lipid was calculated as following:

$$\text{lipid \%} = \frac{\text{Weight of lipid}}{\text{Weight of sample}} \times 100$$

Ash content: About 3-5 g prepared sample was taken in a pre-weighed porcelain crucible and was placed in muffle furnace at 550°C for 6 hours. Then the crucibles were cooled in desiccators. After recording the weight of ash, the ash content percentage of the samples could be computed as following:

$$\text{Ash content \%} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

Evaluation of the Proximate Biochemical Composition of Sun-Dried Fish (Wazef) in Yemen

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Abstract. The well-known dried fish locally named as “wazef” is traditionally prepared in some coastal areas of Yemen. Biochemical composition (moisture, protein, lipids and ash) of the dried fish available in the markets of Yemen were estimated. Estimation of pH was also carried out. Samples were collected from various condiment shops in three cities of the country namely, Sana'a, Taiz, and Hodeidah. The moisture content of samples was ranged from 4.06% to 12.80, while protein varied from 32.63 % to 55.92 % and formed the highest percent of the components estimated. Lipids content was also high and ranged between 30.86% and 38.73 %. Ash content varied from 13.47% to 22.25% and the carbohydrate present the lowest component and varied from 3.20% to 3.74 %. The pH values of the samples were fluctuated in a narrow range between 6.03 and 6.20. Satisfactory amount of protein, lipids and ash highlighted this dried fish as a good preserved food. There is no significant difference ($P>0.05$) between the results based on the location of sample collection.

Keywords: Wazef, Dried fish, Moisture, Protein, Lipid, Ash, Yemen.

1. Introduction

Seafood is one of the most popular dish serves on the table of different communities. Among seafood, fish is classified as one of the healthiest foods on the Earth. People from different communities all over the world consume fish for several reasons. In addition to its edibility, fish offer good prices for the poor societies. Approximately 16 % of animal proteins consumed by the world's population are derived from fishes, and over one billion people depend on fish as their main source of animal proteins (FAO, 2000). Fishes play an important role in human diets which form a good source of nutrients, such as high quality protein, vitamins, minerals and polyunsaturated fatty acids (Srivastava, 1999;

Ravichandran *et al.*, 2012; Immaculate *et al.*, 2013). Such elements are important for the maintenance of body health. Fish protein possesses less collagen fibers than the protein found in meat, which makes it more digestible comparing with other sources of protein (Akpambang, 2015).

The importance of knowing the biochemical composition of edible fishes lies in giving an image of the contribution that fish could make in the diet and health. It will also help the food producers to define the optimum processing and storage conditions.

Sun-drying is considered as the most convenient, oldest and cheapest method used for the purpose of fish preservation (Balachandran, 2001). However, information