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RESEARCH ARTICLE

Comparison of Different Analysis Methods for Determination of Nutrient Composition of Fish Meal Produced from Anchovy (*Engraulis encrasicolus*)

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ABSTRACT

In this study, nutrient composition analyses of fish meal obtained from anchovy fish caught in October 2022-2023 fishing season were made in two ways and the results were compared. In the first method, the analyses were made using the Bruker type MPA brand spectrophotometer device used in fishmeal-oil factories operating in the Black Sea. In the second method, crude protein, crude oil, moisture, and crude ash analyses were made by chemical methods in the laboratory. As a result of the analysis made with Bruker type, average values of crude protein, crude oil, moisture, and crude ash were determined as 75.30%, 11.43%, 3.67%, and 9.62%, respectively. When the same analysis results were made with chemical methods, the average were found to be 73.81%, 12.10%, 2.51%, and 11.63% respectively. It was determined that the results were close to each other in both methods. As a result, it is thought that the use of MPA brand spectrophotometer devices will be beneficial in determining the nutrient composition analyses in the fishmeal-oil sector (shortening the analysis time and giving accurate results).

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Introduction

Turkey is one of the fastest growing countries in fish farming worldwide (Bayraklı & Duyar, 2019a). Aquaculture production has grown rapidly in the last 10 years, exceeding the amount of fishing production in total production (TÜİK, 2021). While this production makes significant contributions to the aquaculture sector and our country's economy, it also brings some problems. Feed production and raw material supply are the most important issues in fish farming. In addition, feed costs constitute the most important expense item in the fish farming industry (Bayraklı & Duyar, 2019b).

Fish meal is used as the main protein source in feed rations in the aquaculture industry (Duyar & Bayraklı, 2005). Fish meal is an important raw material that affects feed costs. Despite the success in fish feeding studies using different protein sources instead of fish meal in recent years, no one-to-one alternative has been found yet.

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Fish meal is produced from whole fish or by processing fish residues. However, it is seen that the amount of aquaculture production in the world has not increased. It is also predicted that fishing production will not increase due to global warming, climate change pollution, and hunting pressure on fish species. Therefore, it can be said that the amount of fishmeal production will not increase in the face of such a scenario. It is an expected situation that fishmeal prices may increase continuously in order to meet the increasing demands of aquaculture.

Turkey is the country that produces the most fish meal among the countries with a coast to the Black Sea. Fishmeal production in the territorial waters of our country is carried out in fishmeal-oil factories in the Central Black Sea and Eastern Black Sea Regions, considering the processing of anchovy fish caught along the Black Sea coasts (Bayraklı & Duyar, 2021a, 2021b). Although anchovy is in the first place in fish meal production, sprat, which is an alternative to anchovy, is also caught close to these regions (Bayraklı et al., 2019). Especially in the Samsun region, it is possible to reduce the fishing pressure on anchovy by processing sprat fish, which is caught in significant amounts by midwater trawler fishing activities, in factories (Özdemir et al., 2010; Özdemir et al., 2018). In addition, thanks to sprat fish, which can be caught with middle water trawl nets, the contribution of fishmeal oil factories to the aquaculture sector of our country increases (Özdemir et al., 2020). In recent years, due to the increasing aquaculture activities in this region, fish residues have also started to be evaluated as fish meal.

Fishmeal production facilities measure the absorption of visible light in the desired sample with a Bruker type MPA brand spectrophotometer, determine the nutrient compositions, and report the results. The aim of this study is to determine the crude protein, crude oil, moisture, and crude ash results measured in fish meal in the factories, Kjeldahl method (AOAC-981.10, 1998), crude oil analysis Bligh and Dyer (1959), moisture Ludorff and Meyer (1973) and for the determination of raw ash (AOAC-935.47, 1998).

Materials and Methods

Materials

The research was carried out in the province of Sinop, which processed anchovy (*Engraulis encrasicolus*, L.) as an alternative product and brought it to the aquaculture sector in October 2022, when it was caught in the Black Sea in large quantities and could not be offered to human consumption for nutritional purposes. It was carried out in a private factory.

Methods

2 Fishmeal samples taken from the factory at different times were first measured 4 times with a Bruker type MPA brand spectrophotometer (1.1 and 1.2). After the analysis results were reported, the same sample was put into 500 g nylon bags and labelled. These samples were delivered to Sinop University Scientific Research and Application Center (for crude oil, moisture, and crude ash analysis) and Sinop University Fisheries Faculty Laboratory (for crude protein analysis) for analysis (1.2 and 2.2).

The Kjeldahl method (AOAC-981.10, 1998) for Crude Protein was performed using Bligh and Dyer (1959) for crude oil analysis, Ludorff and Meyer (1973) for moisture, and (AOAC-935.47, 1998) for crude ash determination.

Statistical analysis

Data obtained from two different time periods were analysed by Student's t-test analysis using SPSS statistical package program (Version 10, SPSS Inc., Chicago, IL, USA) and differences between means were compared by applying Duncan's multiple interval. Significance level ($p<0.05$) was used and results were shown as mean values±SD.

Results and Discussion

In the study, 2 samples were taken from the same factory and each sample was analysed with Bruker type MPA brand spectrophotometer in the factory and with chemical analysis methods in the laboratory with 4 replications.

The nutrient compositions of fishmeal measured with the spectrophotometer device (1.1, 2.1) used in the fishmeal-oil factory and measured by chemical methods (1.2, 2.2) were shown in the Table 1.

In the first sampling (1.1, 1.2), crude protein, crude oil, moisture, and crude ash values were determined as 74.10±0.18%, 12.89±0.09%, 3.40±0.24%, and 9.60±0.06%, respectively, in spectrophotometer measurements, while chemical measurement values were determined as 73.02±0.21%, 13.10±0.13%, 2.34±0.16%, and 11.55±0.22%, respectively. In the second sampling (2.1, 2.2), crude protein, crude oil, moisture, and crude ash values were determined as 76.41±0.28%, 10.03±0.29%, 3.93±0.05%, and 9.63±0.12%, respectively, in spectrophotometer measurements, while chemical measurement values were determined as 74.61±0.26%, 10.99±0.13%, 2.68±0.06%, and 11.71±0.23%, respectively.

Although the difference between the groups was small in amount, it was statistically significant ($p<0.05$). Differences were also detected between the samples made with the same devices in both samples, these differences were also found to be small in quantity but statistically significant ($p<0.05$).

Table 1. Fishmeal nutrient composition results measured by spectrophotometer and chemical methods proportional to 100% over the total results (%).

	Crude Protein	Crude Oil	Moisture	Crude Ash
1.1	74.10±0.18	12.89±0.09	3.40±0.24	9.60±0.06
1.2	73.02±0.21	13.10±0.13	2.34±0.16	11.55±0.22
2.1	76.41±0.28	10.03±0.29	3.93±0.05	9.63±0.12
2.2	74.61±0.26	10.99±0.13	2.68±0.06	11.71±0.23

Fish meal is used as a protein source in fish feed rations. For this reason, it is aimed to separate the oil and water from the raw material fish at the maximum rate in order to have the highest protein ratio with the final product. In addition, in order to prevent rancidity or deterioration that may occur as a result of oxidation and microbial activity, the crude fat ratio in fish meal is expected to be below 10% (FAO, 1986). It has been reported by the researchers that the moisture content varies between 3.4-14.0%, crude oil rate was 4.8-17.3%, crude protein was 59.10-77.0%, and the crude ash rate ranged between 9.7% and 26.4% (Barlow & Pike, 1977; Cho et al., 1987; Ricque-Marie et al., 1998; Ariyawansa, 2000; Opstvedt et al., 2000; De Koning, 2005; Duyar & Bayraklı, 2005; Bayraklı & Duyar, 2019a). The moisture content obtained in the samples taken in this study was found to be above 10%, but this result was among the values reported in many studies. In recent years, the integration of the cooling system after drying into the fish processing process has caused the humidity to be lower. Although the crude oil ratios found in this study are among the results obtained by other researchers, they were found to be higher than Bayraklı and Duyar (2021a) studies, especially in the same region and on the same species. The amount of crude protein found in this study was found to be between the values obtained in other studies. The raw ash rate in this study was determined among other research results. The nutritional composition of fishmeal varies according to the type of fish being processed, its freshness, and the use of the fish (whole, processed fish residue), the storage conditions of the fishmeal, the processing method, the drying temperature, and time (Anderson et al., 1993).

As a result, Bruker type MPA brand spectrophotometer device used in fishmeal-oil factories makes measurements of fishmeal nutrient compositions close to chemical analysis methods. For this reason, the use of these devices in the nutrient composition analyses of fish flours produced in factories may contribute to the establishment of certain standards in the sector and to obtain faster and more reliable results.

Conflict of Interest

The authors declare that there is no conflict of interest.

References

Anderson, J. S., Lall, S. P., Anderson, D. M., & McNiven, M. A. (1993). Evaluation of protein quality in fish meals by chemical and biological assays. *Aquaculture*, *115*(3-4), 305-325. https://doi.org/10.1016/0044-8486(93)90145-O

AOAC. (1998). *Official methods of analysis*. AOAC International, Gaithersburg.

Ariyawansa, S. (2000). *The evaluation of functional properties of fish meal*. Fisheries training programme, final project.

Barlow, S. M., & Pike, I. E. (1977). *The role of fat in fish meal in pig and poultry nutrition*. Technical Bulletin No: 4, International Association of Fish Meal Manufacturers. Potters Bar.

Bayraklı, B. Özdemir, S., & Duyar, H. A. (2019). A study on fishing and fish meal-oil processing technology of anchovy (*Engraulis encrasicolus*) and european sprat (*Sprattus sprattus*) in the Black Sea. *Menba Journal of Fisheries Faculty*, *5*(2), 9-16.

Bayraklı, B., & Duyar, H. A. (2019a). Nutritional composition of fishmeal obtained from different raw materials in the Black Sea. *Journal of Anatolian Environmental and Animal Sciences*, *4*(3), 545-550. https://doi.org/10.35229/jaes.636806

Bayraklı, B., & Duyar, H. A. (2019b). The effect of raw material freshness on fish oil quality produced in fish meal & oil plant. *Journal of Anatolian Environmental and Animal Sciences*, *4*(3), 473-479. https://doi.org/10.35229/jaes.636002

Bayraklı, B., & Duyar, H. A. (2021a). Effect of freshness on fish meal quality; Anchovy meal. *Journal of Anatolian Environmental and Animal Sciences*, *6*(1), 57-65. https://doi.org/10.35229/jaes.824885

Bayraklı, B., & Duyar, H. A. (2021b). The effect on fishmeal element quality of different processing methods: Evaporator system. *Marine Science and Technology Bulletin*, *10*(3), 251-257. https://doi.org/10.33714/masteb.922865

Bligh, E. G., & Dyer, W. J. (1959). A rapid methods of total lipid exraction and purification. *Canadian Journal of Biochemistry and Physiology*, *37*(8), 911-917. https://doi.org/10.1139/o59-099

Cho, H. O., Byun, M. W., Kwon, J. H., & Lee, J. W. (1987). Effect of gamma irradiation and ethylene oxide fumigation on the quality of dried marine products (shrimp, anchovy). *Korean Journal of Food Hygiene*, *2*(1), 21-27.

De Koning, A. J. (2005). Properties of South African fish meal: A review. *South African Journal of Science*, *101*(1-2), 21-25.

Duyar, H. A., & Bayraklı, B. (2005). Sinop ilinde bulunan su ürünleri işleme tesislerinin durumu, sorunları ve çözüm önerileri. *Su Ürünleri Mühendisleri Dergisi (SUMDER)*, *24*(4), 53-56. (In Turkish)

FAO. (1986). *The production of fish meal and oil*. https://www.fao.org/3/x6899e/x6899e00.htm

Ludorff, W., & Meyer, V. (1973). *Fische und fischerzeugnisse*. Verlag Paul Parey.

Opstvedt, J., Mundheim, H., Nygard, E., Aase, H., & Pike, I. H. (2000). Reduced growth and feed consumption of Atlantic salmon (*Salmo salar* L,) fed fish meal made from stale fish is not due to increased content of biogenic amines. *Aquaculture*, *188*(3-4), 323-337. https://doi.org/10.1016/S0044-8486(00)00343-4

Özdemir, S., Erdem, E., Aksu, H., & Birinci Özdemir, Z. (2010). Determination of catch composition and length-weight relationship of some pelagic fishes caught by pairly midwater trawl. *Journal of FisheriesSciences.com*, *4*(4), 427-436. https://doi.org/10.3153/jfscom.2010046

Özdemir, S., Erdem, Y., Birinci Özdemir, Z., Erdem, E., & Aksu, H. (2018). Estimation of growth parameters and mortality rates of sprat (*Sprattus sprattus* L.) and anchovy (*Engraulis encrasicolus*, L.) captured in the Black Sea. *Turkish Journal of Maritime and Marine Sciences*, *4*(2), 106-115.

Özdemir, S., Duyar, H. A., & Bayraklı, B. (2020). Karadeniz kıyılarında avlanan hamsi (*Engraulis encrasicolus*) balığının mevsimsel olarak boy-ağırlık ilişkisi ve besin madde bileşimleri değişimi. *Menba Kastamonu Üniversitesi Su Ürünleri Fakültesi Dergisi*, *6*(2), 53-62. (In Turkish)

Ricque-Marie, D., Abdo-de La Parra, M. I., Cruz-Suarez, L. E., Cuzon, G., Cousin, M., & Pike, I. H. (1998). Raw material freshness, a quality criterion for fish meal fed to shrimp. *Aquaculture*, *165*(1-2), 95-109. https://doi.org/10.1016/S0044-8486(98)00229-4

TÜİK (Türkiye İstatistik Kurumu). (2021). *Fishery statistics.* https://www.tuik.gov.tr/ (In Turkish)