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Proximate Composition of Three Different Fish (Trout, Anchovy and Whiting) Waste During Catching Season

Üç Farklı Balık Türü (Alabalık, Hamsi ve Mezgit) Atıklarının Avlama Sezonu Boyunca Besin Komposizyonu Bileşimi

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ABSTRACT

The aim of this study was to determine the proximate composition (lipid, crude protein, crude ash and moisture) of three different fish wastes [trout (*Onchoryncus mykiss*), anchovy (*Engraulis encrasicolus*), and whiting fish (*Merlangius merlangus)*] during the catching season (November through April). As a result of the proximate composition, it was varied among the species and months. On wet weight basis, total lipids ranged between 16.4% (January) and 30.5% (November) (w/w) for trout, 5.8% (February) and 8.9% (December) for anchovy and 2.5% (March) and 9.6% (December) for whiting fish wastes. The protein content for all species waste varied between 10.4%- 16.8% among the species studied on wet weight basis. The highest ash content estimated in trout, anchovy, and whiting fish wastes were 4.2% in January, 4.7% in April and 2.6% in December, respectively ($p<0.05$). Moisture content was found in the lowest trout waste (52.3%, November) and the highest whiting waste (81.4%, March). In dry weight basis, the highest lipid, crude protein and ash content in different months were found in trout waste (70.7%, November), whiting waste (65.6%, March) and whiting fish waste (20.7%, March), respectively ($p<0.05$). Marked significant differences basis in wet and dry weight basis were observed among fish species waste for the mean moisture, lipid, and ash contents ($p<0.05$).

Keywords: fish waste, proximate composition, catching season, months

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ÖZET

Bu çalışmada, (alabalık (*Onchoryncus mykiss*), hamsi (*Engraulis encrasicolus*) ve mezgit (*Merlangius merlangus*) atıklarının avlanma mevsimi boyunca (Kasım ile Nisana arası) besin komposizyonunun belirlenmesi amaçlanmıştır. Yapılan çalışma sonucunda, besin komposizyonu türler ve aylar arasında değişiklik göstermiştir. Yaş ağırlığa göre , toplam lipit alabalık atığında % 16.4 (Ocak) ile % 30.5 (Kasım) (a / a), hamsi atığında % 5.8 (Şubat) ve % 8.9 (Aralık), mezgit atığında % 2.5 - % 9.6 arasında değişmiştir. Tüm türlerin atıkları için protein içeriği, yaş ağırlık bazında %10.4- %16.8 arasında değişmiştir. Alabalık, hamsi ve mezgitte tahmin edilen en yüksek kül içeriği sırasıyla, Ocak ayında %4.2, Nisan ayında %4.7 ve Aralık ayında %2.6 olarak bulunmuştur. Nem içeriği en düşük alabalık atığında (% 52,3, Kasım) ve en yüksek mezgit atığında (% 81,4, Mart) tespit edilmiştir. Kuru ağırlık bazında en yüksek lipid, ham protein ve kül içeriği sırasıyla alabalık atığında (% 70.7, Kasım), mezgit atığında (% 65.6, Mart) ve mezgit atığında (% 20.7, Mart) bulunmuştur ($p < 0.05$). Yaş ve kuru ağırlık olarak ortalama nem, lipit ve kül içeriği bakımından balık türleri atıkları arasında belirgin farklılıkların olduğu gözlenmiştir ($p<0.05$).

Anahtar Sözcükler: balık atığı, besin komposizyonu, avlanma mevsimi, aylar

1. INTRODUCTION

Every year, around 20 million tons of fishery products, which consist of irrigated species and processing wastes, are disposed of without any use and this amount corresponds to 25% of annual fishing production (Kim and Mendis, 2006). In the European Union countries, approximately 5.2 million tons of solid waste is produced each year from aquaculture processing, and 3 million tons of these wastes come from the companies that make fillet extraction, salting and smoking (Ferraro et al., 2010). This leads to the loss of valuable nutritional components in terms of nutrition content which, if not properly processed for use in human or animal nutrition, and economic cost increase (Rustad, 2007). On the other hand, disposing of waste processing wastes with rich organic matter content creates a problem in terms of the environment. (Kotzaminis et al., 2001; Kim and Mendis, 2006; Hayes and McKeon, 2014).

The fish processing industry produces more than 60% by-products as waste, which includes head, frames, fins, tails, skin and gut. These fish wastes are a rich source of many value added products such as proteins, amino acids, bioactive peptides, collagen, gelatin, oil, calcium and enzymes (Ramakrishnan et al., 2013). Fish processing wastes are alternatively used as fish mince, applications of fish gelatin, fish as a source of nutraceutical ingredients, fishmeal production, the possible use of fish and protein concentrate as a food source (Jayathilakan et al., 2014).

Limited attention has been paid to studies on the proximate compositions of wastes during catching season. The aim of this study was to assess variability in the proximate composition of three different fish the wastes [trout *(Onchoryncus mykiss*), anchovy (*Engraulis encrasicolus*) and whiting fish (*Merlangius merlangus*)] during the catching season (November through April).

2. MATERIAL AND METHOD

Waste material of trout, anchovy and whiting, which consisted of head, fins, and viscera, gills and vertebral column with adhering meat obtained during filleting of fish, were obtained from a commercial fish processing plant (Figure 1). Fish wastes were iced in a styrofoam boxes and immediately transported to the laboratory. Then, the samples were stored at -80°C until used. To determine the proximate composition, total protein was analyzed using Kjeldahl method (AOAC 981.10, 1998), and lipid analysis was performed using Bligh & Dyer (1959) method. Moisture was determined according to AOAC (1990) and crude ash was analyzed according to AOAC 935.47 (1998).

Figure 1. Trout *(Onchoryncus mykiss*), anchovy *(Engraulis encrasicolus)* and whiting *(Merlangius merlangus)* wastes

3. RESULTS

As a result of statistical analysis, the difference between lipid content of trout, anchovy and whiting wastes were found to be significant according to months ($p<0.05$). The highest lipid content of trout, whiting and anchovy was 30.54% in November, 9.6% in December and 8.87% in December, respectively ($p<0.05$). The highest moisture content was 63.48% in trout waste, 81.4% in whiting waste and 78.6% in anchovy waste ($p<0.05$). The highest ash contents for trout, whiting and anchovy wastes were 4.17% in January, 3.78% and 4.68% in March, respectively ($p<0.05$). The highest protein content of trout and anchovy wastes was 16.84% in January and 13.28% in March, respectively ($p<0.05$). In the whiting waste, the difference between the months in terms of protein was statistically insignificant ($p>0.05$). Marked significant differences ($p<0.05$) were observed among fish species waste for the mean moisture, lipid, and ash contents (Table 1)

Table 1. The proximate compositions of trout, whiting and anchovy wastes (%)

Trout				
Months	**Lipid**	**Moisture**	**Ash**	**Protein**
November	30.539±0.346[e]	52.314±0.784[a]	2.159±0.036[a]	10.522±0.004[a]
December	27.913±0.586[d]	52.825±1.080[a]	3.257±0.005[c]	10.368±0.204[a]
January	16.448±0.355[a]	59.512±0.396[b]	4.167±0.001[e]	16.836±0.269[c]
February	21.077±0.019[c]	60.846±0.790[b]	3.783±0.015[d]	15.794±0.178[c]
March	18.340±0.023[b]	63.210±0.068[c]	2.632±0.328[b]	12.789±1.107[b]
April	18.360±0.163[b]	63.478±0.143[c]	2.340±0.088[ab]	12.577±0.927[b]
Anchovy				
Months	**Lipid**	**Moisture**	**Ash**	**Protein**
November	8.279±0.076[d]	75.132±0.056[a]	4.279±0.013[b]	11.819±0.730[ab]
December	8.874±0.056[e]	74.674±0.202[a]	4.211±0.176[b]	10.924±0.152[a]
January	7.656±0.011[c]	75.198±0.551[a]	4.210±0.140[b]	12.544±0.067[bc]
February	5.726±0.044[a]	78.581±0.326[c]	4.467±0.083[bc]	11.781±0.763[ab]
March	5.845±0.462[a]	77.266±0.310[b]	3.814±0.172[a]	13.276±0.763[c]
April	6.980±0.054[b]	77.793±0.071[b]	4.677±0.051[c]	12.648±0.147[bc]
Whiting				
Months	**Lipid**	**Moisture**	**Ash**	**Protein**
November	8.617±0.422[d]	73.334±0.086[a]	2.680±0.098[a]	11.766±0.680[a]
December	9.557±0.031[e]	73.311±0.231[a]	2.557±0.047[a]	11.930±0.478[a]
January	5.978±0.154[c]	78.103±0.593[b]	3.772±0.410[c]	12.096±0.422[a]
February	5.676±0.586[c]	78.540±0.033[b]	3.287±0.194[b]	11.811±0.316[a]
March	2.522±0.394[a]	81.408±0.002[c]	3.784±0.050[c]	12.002±0.454[a]
April	4.030±0.071[b]	80.767±0.033[c]	3.265±0.036[b]	12.044±0.005[a]

The proximate compositions of trout, whiting and anchovy wastes on dry weight basisare given Table 2. When the lipid, ash and protein levels of trout, whiting and anchovy wastes were taken into consideration on the basis of dry matter, it was found that the difference between the months was significant ($p<0.05$). The highest lipid content in trout waste was determined in November with a significant 70.66%. The highest ash and protein content in trout waste was 11.13% and 44.96% in January, respectively ($p<0.05$).

The lipid content of whiting fish waste was determined in December with 39.76% ($p<0.05$). The highest ash and protein

content in whiting fish waste was 20.67% and 65.56% in March ($p<0.05$).
The highest lipid content in anchovy waste was 36.96% in December ($p<0.05$). The ash content of whiting waste was highest in February (20.33%) ($p<0.05$). Protein content was 57.88% in March ($p<0.05$).

Table 2. The proximate compositions of trout, whiting and anchovy wastes (g/100g dry weight basis)

	Trout		
Months	**Lipid**	**Ash**	**Protein**
November	70,658±0,301^{e}	4,995±0,119^{a}	24,347±0,181^{a}
December	67,197±0,141^{d}	7,843±0,161^{c}	24,960±0,020^{a}
January	43,917±0,217^{a}	11,128±0,188^{e}	44,955±0,030^{c}
February	51,844±0,186^{b}	9,305±0,078^{d}	38,850±0,264^{b}
March	54,372±2,279^{bc}	7,782±0,635^{c}	37,846±1,645^{b}
April	55,199±1,465^{c}	7,032±0,016^{b}	37,769±1,449^{b}
	Anchovy		
Months	**Lipid**	**Ash**	**Protein**
November	33,976±0,831^{d}	17,564±0,535^{a}	48,460±1,366^{ab}
December	36,961±0,110^{e}	17,537±0,674^{a}	45,502±0,785^{a}
January	31,365±0,235^{c}	17,246±0,418^{a}	51,389±0,184^{bc}
February	26,060±0,200^{a}	20,334±0,690^{b}	53,606±0,890^{c}
March	25,492±2,157^{a}	16,632±0,846^{a}	57,876±3,002^{d}
April	28,719±0,076^{b}	19,243±0,010^{b}	52,038±0,067^{bc}
	Whiting		
Months	**Lipid**	**Ash**	**Protein**
November	37,368±2,090^{d}	11,623±0,505^{a}	51,008±2,595^{a}
December	39,755±0,635^{d}	10,640±0,400^{a}	49,606±1,035^{a}
January	27,388±1,556^{c}	17,246±1,341^{b}	55,366±0,215^{b}
February	27,286±1,382^{c}	15,820±0,099^{b}	56,894±1,480^{b}
March	13,742±1,554^{a}	20,696±1,174^{c}	65,562±0,380^{d}
April	20,839±0,247^{b}	16,883±0,089^{b}	62,278±0,336^{c}

4. DISCUSSIONS

When the lipid contents of trout wastes were evaluated according to months, the highest lipid content was 30.54% in November and the highest lipid content of whiting fish and anchovy wastes was 9.6% and 8.87% in December, respectively ($p<0.05$). The presence of head in the content of trout wastes used in our study is thought to increase the lipid value and opted as being a good source of lipid. It is remarked that the lipid contents of fish wastes are similar to findings of other researchers (Nguyen et al., 2011; Suvanich et al., 2006; Tahari et al., 2012; Kolakowska et al., 2006). Changes in lipid contents of fish wastes were evaluated according to months were found to be significant ($p<0.05$). As well, these values are almost similar to those of Nguyen et al. (2011), the average chemical composition of the head, tail and internal organs of the yellow tail (*Thunnus albacares*) were investigated. The most important differences were found in terms of lipid content. Accordingly, the lipid content was found to be 3.73% in the internal organs and tail, while the lipid content in the head region was found to be at least 3 times richer (13%). On the other hand, Suvanich et al. (2006) according to the changes in the nutritional composition of catfish, cod, flounder, mackerel and salmon, and the highest fat content among these fish was found in mackerel (11.7%). Finally, Tahari et al. (2012) found that rainbow trout (*Onchoryncus mykiss)* in viscera lipid content was found %13. In this study, 54.38

% lipid content was determined on dry weight basis in trout waste in March. These values are almost similar to those Kolakowska et al (2006), found that the composition of rainbow trout offal in March %47 lipid.

The highest moisture content was 63.48% in trout, 81.4% in whiting and 78.6% in anchovy in April ($p<0.05$). Other researchers have reported similar findings (Murray et al., 2001; Nguyen et al., 2011; Suvanich et al., 2006). Changes in moisture contents of fish wastes evaluated according to months were found to be significant ($p<0.05$). As well, the moisture values of anchovy waste consist of the head, internal organs and the spine was found as 73.85 ± 0.14% by Koç (2016). On the other hand, Roslan et al. (2015) found that tilapia (*Oreochromis niloticus*) waste contained 66.57% moisture and Detkamhaeng et al (2016) found that yellowtail *(Thunnus albacares*) and Skipjack tuna (*Katsuwonous pelamis)* waste contained 73.17% and 74.51% moisture, respectively. Finally, Tahari et al. (2012) found viscera moisture content of rainbow trout (*Onchoryncus mykiss)* as 71.65 %.

Changes in ash contents of fish wastes evaluated according to months were found to be significant ($p <0.05$). The highest ash content for trout waste was 4.17% in January, 3.78% and 4.68% in March for whiting and anchovy ($p <0.05$). These values are almost similar to those of Koç (2016). As well, Tahari et al. (2012) found the ash content of rainbow trout (*Onchoryncus mykiss)* viscera as %2.73.

The highest protein content of trout was 16.84% in January and 13.28% in anchovy in March ($p <0.05$). It is remarked that the protein contents of fish wastes are similar to findings of other researchers (Nguyen et al., 2011; Tahari et al., 2012; Kolakowska et al., 2006; Koç 2016). Roslan et al. (2015) found that tilapia (*Oreochromis niloticus*) waste contained 14.60% crude protein. As well as Nguyen et al. (2011) investigated the average chemical compositions of the head, tail and internal organs of the yellow tail (*Thunnus albacares*). It was found that all by-products consisted mainly of protein and ranged between 15 to 17%. Similarly, Koç (2016) estimated 14.54 ± 0.05% protein content in anchovy waste consist of the head, internal organs and the spine. Finally, Tahari et al. (2012) found that rainbow trout (*Onchoryncus mykiss)* in viscera protein content was %15. Raghavan (2008) reported that the amount of protein in fish waste can be up to 10-20% of the total protein in fish (w / w). On dry weight basis, %57.9 protein content in anchovy waste was determined in March in this study. These values are almost similar to those Estaban et al., (2007), examined the nutrient composition of wastes obtained from fish-selling businesses. Accordingly, the nutrient composition of wastes for protein 58%.

Ghaedian et al (1998) claimed, most fish contain 15-30% protein, 0-25% fat and 50-80% moisture It is seen that the values obtained by Ghaedian et al. (1998) are close to the results obtained in this study. The chemical composition of fish wastes can vary according to the type of fish, body parts of the waste, season, feeding, and moisture content of waste (Benjakul and Morisey, 1997; Kotzaminis ve ark., 2001; Kołakowska ve ark., 2006).

5. CONCLUSION

In the study, it was determined that the chemical composition of fish wastes may vary according to the type of fish and months during catching season. Regarding to suitable lipid and protein content, all waste in this study could be used as a decent substitute source to extract fish lipid and protein. This lipid and protein could be considered as the attention source for human consumption as well as industrial use. In this sense, in order to prevent waste at source, to encourage recycling, to use waste as source and to extract additional natural resources, it is considered that fish processing wastes could be evaluated in functional food, animal feed, organic fertilizer, medicine and pharmacology

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