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Extended Abstract

The Effect of Antioxidant Properties of Brown Algae (*Iyengaria Stellata*) Extract on the Shelf-life and Sensory Properties of Rainbow Trout *(Oncorhynchus Mykiss)*Fillet Nugget during Frozen Storage (-18 °C)

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Abstract

Due to the high levels of unsaturated fatty acids in fish muscle and increased demand for ready to eat food like nugget, the effect of antioxidant properties of brown algae *Iyengaria stellata* extract on the shelf-life and sensory properties of rainbow trout (*Oncorhynchus mykiss*) fillet nugget during frozen storage were evaluated. The treatments consisted of: first treatment, control (fillet nugget without immersion in algae extract solution), the second treatment (fillet nugget with immersion in 1% algae extract), the third treatment (fillet nugget with immersion in 2% algae extract) and the fourth treatment (fillet nugget with immersion in 3% algae extract). Some chemical and physical experiments during the maintenance months (0, 1, 2 and 3) were carried out at temperature of -18 °C. According to the result, the yield and moisture during storage in all treatments decreased. However, in all treatments during storage, lipid and shrinkage reduced significantly, while the peroxide value (PV), free fatty acids (FFA) and thiobarbituric acid (TBA) showed a significant increase (P<0.05). At the end of the storage time, 1% treatment had the highest yield,cohesiveness, lights index (L), yellow index (b) and the lowest of the shrinkage, springiness, adhesiveness, lipidand 3% treatment had the highest hardness, adhesiveness, adhesiveness force, chewiness and red index (a) and the lowest moisture, peroxide value (PV), free fatty acids (FFA), thiobarbituric acid (TBA) and adhesiveness force. Therefore, applying the *Iyengaria stellata* extract showed reduction in the rate of chemical degradation and improved sensory condition of rainbow trout fillet nugget during frozen storage.

Keywords: Antioxidant, Fillet Nugget, *Iyengaria Stellata*, Rainbow Trout (*Oncorhynchus Mykiss*)

Introductıon

As the population grows, it tends to consume meat products like nuggets of fish. Fish nuggets are a product that is produced by shaping into a bark-free fish fillet, which after being coated

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and cooking is frozen, packaged and stored. Algae is a rich source of bioactive compounds with medicinal and nutritional potential and has a wide range of biological activities (Cox *et al*., 2010). Considering the relatively rich macro-algae flora on the southern coast of Iran, and the acknowledgment of the high potential of algae in the development of food products as well as a wide range of biological activities, and the relative increase and increasing of research in this field, the necessity of this research was discovered. In western countries, types of products such as bread, beverages, spices, sushi, snacks, pizza, pasta, etc. were made from the types of macroalgae, *Ascophyllum nodosum*, *Fucus vesiculosus*, *Pelvetia canaliculata*. The use of these algae improved taste and increased shelf life (Bouga & Combet, 2015). In this study, the effect of algae extract *Iyengaria stellata* on rainbow trout nugget fillet was investigated. The results showed positive effects of algae extract on improving nutritional value and increasing the shelf-life of the product.

Material and methods

Extraction

The algae used in this research gathered from Qeshm Island. Extracts of algae were extracted by aqueous methods (Mohammadi *et al*., 2016).

Nugget production

Rainbow trout was used to produce nugget. The fillets were then immersed in 1, 2, and 3% algae. Then the fillets were baked and cooked and transferred to the freezer for testing.

Yeild

According to the method (Das *et al*., 2008), the product yield was calculated.

Shrinkage

According to the method (Modi *et al*., 2007), the product shrinkage was calculated.

Chemical

Indicators FFA, PV and TBA were mapped to the method (Igan *et al*., 1979), The moisture and fat content was determined by the method (Parvaneh *et al*., 1998). Tissue and colorimetric measurements were also measured by (Sahin *et al*., 2005).

Statistical analysis

Statistical analysis was performed using software SPSS.

Results and discussion

Yeild

According to Table (1), nugget fillets with 1% algae extract during the storage period had the highest yield. Which was consistent with the results of research Maskat (2005) and Killincceker & Hepsage (2012).

Shrinkage

There is a direct relationship between shrinkage and moisture loss (Ziaiifar, 2008). In this realization, 1% treatments showed the least moisture loss and thus the least shrinkage.

Moisture and fat

Moisture and fat levels have a relationship (Ojagh *et al*., 2013). As a result, 1% treatment showed the lowest fat and 3% treatment had the highest fat content at the end of the period.

Table 1. Changes in the rate of yield (%), shrinkage (%), moisture content (%), fat (%), and free fatty acid (percentage of acidoilic acid). Fillet Ngut treatments for 3 months frozen storage

Factor	Time (month)/Treatment	0	1	2	3
yeild	Control	90.06 ±0.45 ^{Ab}	88.63 ±1.14 ^{Ac}	89.13 ±0.54^{Ab}	87.31 ±1.02 ^{Bb}
	1%	91.21 ±0.72 ^{Aa}	90.88 ±0.17 ^{Aa}	91.41 ±0.46^{Aa}	89.78 ±0.67 ^{Aa}
	2%	90.43 ±0.30 ^{Aab}	89.31 ±0.61 ^{Ab}	90.14 ±0.66^{Aab}	89.42 ±1.17 ^{Aa}
	3%	85.76 ±0.75 ^{ABc}	84.31 ±0.46^{BCb}	86.76 ±1.09^{Ac}	83.97 ±0.62 ^{Cc}
Shrinkage	Control	2.51 ±0.12 ^{Bb}	2.41 ±0.20 ^{Bb}	3.14 ±0.63^{Ac}	3.65 ±0.42 ^{Aab}
	1%	2.91 ±0.74 ^{Bab}	3.64 ±0.37 ^{Ba}	4.56 ±1.43^{Aa}	2.61 ±0.82 ^{Cd}
	2%	2.88 ±0.72 ^{Cab}	3.54 ±0.60 ^{ABa}	4.28 ±0.47^{Ab}	3.42 ±0.33 ^{Bc}
	3%	2.99 ±0.77 ^{Ca}	3.04 ±0.52 ^{Bab}	4.26 ±0.51^{Ab}	3.95 ±0.55 ^{ABa}
Moisture	Control	59/86 ±0/30 ^{Aa}	58.23 ±0.15 ^{Aa}	57.03 ±0.30^{Aa}	56.23 ±1.55 ^{Bb}
	1%	58.20 ±4.94 ^{Aa}	54.20 ±0.10 ^{ABa}	52.93 ±0.58^{Bb}	57.63 ±0.20 ^{ABa}
	2%	59.29 ±0.17 ^{Aa}	54.50 ±5.48 ^{ABa}	53.06 ±0.72^{Bb}	56.60 ±0.26 ^{ABb}
	3%	57.03 ±0.55 ^{Aa}	55.06 ±1.71 ^{ABa}	54.00 ±1.86^{Bb}	56.10 ±0.26 ^{ABb}
Fat	Control	13.50 ±0.02 ^{Ab}	12.87 ±0.06 ^{ABab}	12.25 ±0.75^{BCb}	11.40 ±0.02 ^{Ca}
	1%	13.30±0.02 ^{Ab}	12.23 ±0.95 ^{Ab}	11.20 ±0.10^{Cc}	7.10 ±1.10 ^{Bb}
	2%	14.83 ±0.02 ^{Aa}	12.40 ±0.10 ^{Bb}	11.95±0.55^{Abc}	7.15 ±0.25 ^{Db}
	3%	14.51 ±1.02 ^{Aab}	13.70±0.30 ^{ABa}	13.30 ±0.10^{ABa}	11.85 ±0.55 ^{Ba}
FFA	Control	0.83 ±0.08 ^{Ca}	0.43 ±0.22 ^{Ca}	1.43 ±0.15 ^{Ba}	1.95 ±0.28 ^{Aa}
	1%	0.50 ±0.02 ^{Cb}	0.41 ±0.09 ^{Ca}	1.42 ±0.13 ^{Ba}	1.78 ±0.28 ^{Ab}
	2%	0.31 ±0.17 ^{Bc}	0.29 ±0.01 ^{Bab}	1.22 ±1.25 ^{Aab}	1.43 ±0.35 ^{Ac}
	3%	0.28 ±0.02 ^{Bc}	0.14 ±0.01 ^{Bb}	1.06 ±0.08 ^{Ab}	1.40 ±0.49 ^{Ac}

The data are expressed as mean of three replications±standard deviation. (a-d) in each column represents the difference in treatment at any time, and (A-D) in each row represents the variation of each treatment over time. The control group had no algae extract and the rest of the treatments contained 1, 2 and 3% of the algae extract of *Iyengaria stellata*.

FFA

According to Table (2), the lowest amount of FFA showed 3% treatment due to the antioxidant properties of algae extract *I. stellata* (Mohammadi *et al*., 2016).

Table 2. Peroxide value change (Oxygen MEL) and Thiobarbituric Acid Index (Malondialdehyde). Different fillet fillets were stored frozen for 3 months.

Factor	Time (month)/Treatment	0	1	2	3
PV	Control	13.41 ±1.07 ^{Ba}	12.14 ±0.38 ^{Ba}	12.69 ±0.93 ^{Ba}	20.61 ±1.34 ^{Aa}
	%1	12.05 ±1.01 ^{Ba}	11.62 ±0.44 ^{Ba}	12.16 ±1.64 ^{Bab}	15.96 ±0.63 ^{Ab}
	%2	10.31 ±0.58 ^{Cb}	9.61 ±0.38 ^{Cb}	12.13 ±0.19 ^{Bab}	13.64 ±0.27 ^{Ac}
	%3	10.36 ±0.52 ^{Bb}	9.56 ±0.13 ^{Bb}	10.39 ±0.45 ^{Bb}	11.57 ±0.89 ^{Ad}
TBA	Control	0.76 ±0.54 ^{Ba}	1.70 ±0.23 ^{Ca}	3.27 ±0.41 ^{Ba}	4.78 ±0.36 ^{Aa}
	%1	0.62 ±0.08^{Ba}	1.63 ±0.05 ^{Ca}	2.51 ±0.13 ^{Bb}	4.34 ±0.01 ^{Ab}
	%2	0.39 ±0.01 ^{Ba}	0.84 ±0.21 ^{Cb}	2.07 ±0.03 ^{Bc}	3.46 ±0.05 ^{Ac}
	%3	0.34 ±0.01 ^{Ba}	0.74 ±0.24 ^{Cb}	1.60 ±0.20 ^{Bd}	2.67 ±0.03 ^{Ad}

The data are expressed as mean of three replications ± standard deviation. (a-d) in each column represents the difference in treatment at any time, and (A-D) in each row represents the variation of each treatment over time. The control group had no algae extract and the rest of the treatments contained 1, 2 and 3% of the algae extract of *Iyengaria stellata*.

PV and TBA

Minimum amount Pv and TBA were observed during treatment period in 3% treatment. Which can be due to the antioxidant properties of algae extract *I. stellata* (Mohammadi *et al*., 2016).

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Colorimetric

Treatments containing 1% algae extract had a brighter color than other treatments. Because the moisture content is directly related to the brightness (Albert *et al*., 2009).

Texture comparison

At the end of the maintenance period, 3% of the algae extract had the highest hardness, due to the high concentrations of algae extract, low moisture content compared to other treatments, strong antioxidation activity against protein denaturation and, as a result, a higher level of hardness in this treatment than other Treatments (Masnium *et al*., 2005; Altunakar *et al*., 2006).

Sensory evaluation

The process of changing the sensory sensory traits in the treatments during the maintenance period is in line with the oxidation changes in the tested treatments. (Rodrigoez *et al*., 2008).

Conclusion

Brown algae extract of *I. stellata* with a concentration of 3% preserves the quality of fish nugget fillet in terms of chemical and sensory characteristics and prolongs the shelf-life of the product.

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