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Effect of clove oil treatment on the frozen storage Indian mackerel (*Rastrelliger kanagurta*) steaks

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SUMMARY :

The antioxidant effect of clove on the frozen storage stability of fish steak from Indian mackerel (*Rastrelliger kanagurta*) was studied. Fresh mackerel as a raw material had moisture content 73.99 per cent, crude protein 18.16 per cent, crude fat 3.73 per cent and ash 1.71 per cent. The steaks from whole mackerel were treated with Clove oil 0.5, 1.0 and 1.5 ml per lit. of distilled water for 5 minute. All samples were stored at -18 ± 2°C for the six months storage and experimental analysis. Based on the overall acceptability scores, 0.5 ml clove oil treatment is found to better consumer acceptance than other samples during storage.

KEY WORDS : Clove oil, Mackerel, *Rastrelliger kanagurta*, Steak, Frozen storage

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Many studied of effect have been carried out on the fish quality for different fish species during frozen storage (Chakrabarti and Chaudhary, 1987; Shenoy and James, 1972; Nair *et al*., 1976 and Agarwal, 1984). Fish is a highly perishable commodity having relatively shorter shelf-life. In fatty fish, oxidation of the lipid fraction of muscle tissue is a major cause of quality deterioration (Nawar *et al.*, 1990).

Mackerel is a pelagic fatty fish having high fat content. Consumer prefers mackerel in fresh form. Value addition of Indian mackerel can be done by making of steaks from the whole fish. But it is important that the oxidative changes needs to be prevented during storage. Many antioxidants (synthetical or chemical) available in market for prevent the oxidative changes in fish product. But some chemicals are to be harmful for the meat of fish product. At present, there is an increasing demand for the selection of naturally occurring antioxidants. Clove oil is natural oil with its main ingredient eugenol.

EXPERIMENTAL METHODS

R. kanagurta of mean total length 24.0 cm, standard

length 19.79 cm weight 168.2 g used as raw material for experiment. Fresh fish was collected from a local fish market in Okha, Gujarat, India. The samples were iced 1:1 ratio and transported to the laboratory and were cut into steaks of 2.5 cm length (mean weight 8 to 38 g). The steaks were treated with Clove oil 0.5, 1.0 and 1.5 ml per liter of distilled water for 5 minute. Control and treated samples were frozen at - 40^{O}C. The frozen steaks were packed in low density polyethylene bags. The frozen mackerel steaks were stored at -18 ± 2^{o}C for the six months storage and experimental analysis.

Proximate compositions like protein, moisture, lipid and ash were determined as per standard method (AOAC, 2006). Peroxide value (PV) was also determined as per standard methods described in AOAC (2006). Total volatile based nitrogen (TVBN) was determined by the Conway micro diffusion method (Beatty and Gibbons, 1937). Free fatty acid (FFA) was determined as described by Takagi *et al.* (1984). The microbiological characteristic of mackerel steaks was carried out according to standard method of TPC recommended by AOAC (2006). Organoleptic evaluation was carried out by 9 point Hedonic scale method (Joseph, 2003).

Table 1 : Mean value of proximate composition of raw mackerel fish **[Mean value ± Standard deviation (S.D.) value]**

Parameters	Percentage (wet wt. basis)
Crude protein	18.16 ± 0.11
Moisture	73.99 ± 2.65
Crude fat	3.73 ± 1.42
Ash	1.71 ± 0.81

Table 2 : Chemical and microbiological changes in mackerel during frozen storage **(Mean value ± S.D.)**

Parameters	Storage days	Control	0.5 ml clove treated	1.0 ml clove treated	1.5 ml clove treated
TVB-N (mg %)	0	11.20 ± 2.62	10.92 ± 2.50	10.64 ± 5.11	10.36 ± 1.60
	30	21.08 ± 1.72	19.18 ± 1.53	17.78 ± 2.08	16.94 ± 1.83
	60	32.23 ± 2.16	27.16 ± 3.04	23.80 ± 0.77	22.68 ± 3.77
	90	44.38 ± 5.72	39.06 ± 2.80	33.18 ± 2.69	29.82 ± 0.77
	120	46.48. ±2.34	42.28 ± 2.90	38.92 ± 1.17	36.68 ± 4.49
	150	52.95 ± 1.18	48.16 ± 2.12	43.40 ± 3.57	41.16 ± 0.77
	180	58.10 ± 3.51	53.06 ± 2.80	46.06 ± 2.62	42.14 ± 2.69
PV (millimoles	0	0.54 ± 0.18	0.52 ± 0.21	0.49 ± 0.18	0.49 ± 0.17
O_2/kg of fat)	30	10.03 ± 1.32	8.05 ± 0.48	6.04 ± 0.44	3.76 ± 0.61
	60	25.37 ± 0.98	15.32 ± 0.66	7.82 ± 0.92	5.88 ± 0.18
	90	34.70 ± 1.29	23.23 ± 0.95	16.86 ± 1.37	14.98 ± 2.10
	120	46.37 ± 2.39	31.84 ± 1.72	22.40 ± 0.55	20.78 ± 1.16
	150	48.28 ± 3.57	35.87 ± 0.72	25.69 ± 1.04	24.79 ± 0.33
	180	51.44 ± 0.59	40.32 ± 1.80	33.19 ± 0.60	28.94 ± 1.33
FFA	0	0.50 ± 0.01	0.49 ± 0.04	0.49 ± 0.05	0.48 ± 0.01
(% of oleic acid)	30	1.82 ± 0.07	1.58 ± 0.12	0.85 ± 0.04	0.70 ± 0.08
	60	2.16 ± 0.09	1.83 ± 0.13	1.22 ± 0.14	1.06 ± 0.06
	90	2.64 ± 0.13	2.19 ± 0.05	1.63 ± 0.05	1.31 ± 0.07
	120	3.44 ± 0.14	2.92 ± 0.12	2.62 ± 0.12	1.66 ± 0.05
	150	4.62 ± 0.29	4.55 ± 0.13	2.89 ± 0.15	2.04 ± 0.16
	180	5.69 ± 0.17	5.49 ± 0.11	3.38 ± 0.34	2.51 ± 0.32
TPC	0	5.15 ± 0.18	5.06 ± 0.29	5.07 ± 0.19	4.95 ± 0.30
(log cfu/g)	30	5.12 ± 0.14	4.96 ± 0.30	4.98 ± 0.17	4.88 ± 0.22
	60	5.03 ± 0.18	4.97 ± 0.05	4.88 ± 0.19	4.84 ± 0.22
	90	4.96 ± 0.18	4.88 ± 0.28	4.86 ± 0.18	4.80 ± 0.28
	120	4.96 ± 0.09	4.86 ± 0.33	4.88 ± 0.18	4.83 ± 0.17
	150	4.94 ± 0.11	4.91 ± 0.11	4.85 ± 0.21	4.78 ± 0.30
	180	4.88 ± 0.23	4.87 ± 0.15	4.82 ± 0.18	4.76 ± 0.21

EXPERIMENTAL FINDINGS AND ANALYSIS

The proximate composition of the fresh mackerel is given in Table 1. The fat content (3.73%) was found to be medium in the fish and moisture and fat accounted for 77.72 per cent of the total composition. Yield of mackerel steak (25.59 g each piece) is 64.6 per cent from whole fish by manual cutting.

Chemical and microbiological changes in mackerel during frozen storage is given in Table 2. Concerning the TVB-N value increase during frozen storage, same increasing trend found in frozen minced fish (Vareltzis *et al.*, 1997 and Suvanich *et al.*, 2000). This increase can be explained as a result of the breakdown of endogenous compounds into non-protein N-compound. Peroxide value (PV) is a measure of the first stage of oxidative rancidity (Balachandran, 2001). Pearson (1970) suggested that the acceptable level of PV is 20 to 40 millimoles O_2 per kg of fat. The peroxide value increased in all the samples and the sample treated with 1.5 ml clove oil solution showed lower peroxide value than other samples.

Ingalls *et al.* (1950) reported that the fat of frozen white fish muscle stored for 4 months become rancid. Shenoy and James, 1972 reported that the lipid slowly underwent hydrolysis, the registering a value of 5 per cent after 24 weeks of frozen Tilapia storage. FFA (in % of oleic acid) increase in all sample with increase storage periods. In last treatment 2.0 ml clove oil solution showed FFA value than other samples. TPC (in log cfu/g) shows lower in treated sample with clove oil as compare to control sample of fish steaks. TPC counts decrease with increase storage period due to low temperature.

Change in sensory quality of mackerel steaks during frozen storage of all samples in Table 3. Sensory scores

Table 3 : Change in sensory quality of mackerel steaks during frozen storage **(Mean value ± S.D.)**

Parameters	Storage days	Control	0.5 ml clove treated	1.0 ml clove treated	1.5 ml clove treated
Appearance and colour	0	8.6 ±0.42	8.3 ±0.25	8.1 ±0.70	7.9 ±0.69
	30	7.6 ±0.58	7.7 ±0.69	7.5 ±0.76	7.6 ±0.85
	60	7.0 ±0.71	7.4 ±1.11	7.2 ±0.56	7.1 ±0.85
	90	6.7 ±0.73	7.2 ±0.75	6.6 ±0.40	6.6 ±0.66
	120	6.0 ±0.19	6.2 ±0.76	6.1 ±0.22	6.1 ±0.65
	150	5.0 ± 0.90	6.2 ±0.25	6.4 ±0.42	5.9 ±0.22
	180	4.24 ±0.43	5.6 ±0.42	5.5 ±0.79	5.2 ±0.6
Flavour	0	8.2 ±0.92	8.3 ±1.41	8.3 ±0.91	8.1 ±0.75
	30	7.3 ±1.04	7.7 ±0.44	7.7 ±0.43	7.6 ±1.28
	60	7.1 ±1.12	7.6 ±0.87	7.4 ±0.47	7.1 ±0.94
	90	6.6 ±0.55	7.1 ±0.74	6.9 ±0.42	6.7 ±0.67
	120	6.5 ±0.71	7.1 ±0.22	6.12 ±0.27	6.1 ±0.74
	150	5.9 ±0.65	6.4 ±0.58	5.80 ±0.76	5.9 ±0.22
	180	4.8 ±0.57	5.5 ±0.50	5.1 ±0.50	5.4 ±0.42
Texture	0	8.5 ±0.92	8.4 ±0.89	8.3 ±0.69	8.3 ±0.27
	30	6.8 ±0.56	7.5 ±0.94	7.4 ±0.37	7.2 ±1.04
	60	6.4 ±0.74	7.2 ±1.32	7.0 ±0.35	6.8 ±0.57
	90	6.0 ±0.35	7.1 ±0.42	7.1 ±0.22	6.6 ±0.65
	120	6.1 ±0.42	6.5 ±0.61	6.0 ±0.35	5.7 ±0.45
	150	5.8 ±0.57	5.8 ±0.84	6.0 ±0.61	5.6 ±0.65
	180	4.5 ±0.94	5.0 ±0.79	4.7 ±0.76	4.5 ±0.50
Overall acceptability	0	8.4 ±0.38	8.3 ±0.20	8.2 ±0.49	8.1 ±0.45
	30	7.2 ±0.42	7.6 ±0.41	7.5 ±0.32	7.5 ±0.74
	60	6.8 ±0.74	7.4 ±0.37	7.2 ±0.18	7.0 ±0.58
	90	6.4 ±0.32	7.1 ±0.46	6.9 ±0.24	6.6 ±0.23
	120	6.2 ±0.19	6.6 ±0.28	6.1 ±0.19	6.0 ±0.32
	150	5.6 ±0.39	6.1 ±0.28	6.1 ±0.30	5.9 ±0.14
	180	4.5 ±0.31	5.4 ±0.30	5.1 ±0.48	5.0 ±0.33

Steaks of 2.5 cm length (mean weight 8 to 38 g)

Fish steak with reddish fatty meat

64.6 per cent yield of steak from whole fish

Fish waste

Fish steaks

Clove oil

Dip treatment in clove solution for 5 minute

Frozen fish steak

Packaging of mackerel steaks

Freezer

were found to decrease with an increase in storage period. There was a significant difference between the control and clove treated samples and the overall acceptability of 0.5 ml clove treated samples found to be better consumer acceptance compared to other samples. 0.5 ml clove treated mackerel steaks contain less clove odour and flavour as compared to other clove treated samples.

Conclusion:

In present study, it is observed that treatment with clove oil in mackerel steaks had a significant effect in extending the shelf-life during frozen storage. From the overall acceptability scores, 0.5 ml clove oil treatment is found to better consumer acceptance than other samples during storage.

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