Effect of Spices on Improving the Stability of Frozen Stored Fish Mince

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The frozen storage characteristics of minced fish incorporated with different concentrations of clove, cinnamon and pepper were studied. Clove was found to have strong antioxidant effect. As the concentration of the spices increased a proportional increase in the frozen storage stability was noticed. Higher concentrations of clove and pepper (0.2%) were not appreciated by the taste panel. No consistent and concordant TBA values were obtained for samples incorporated with cinnamon and pepper while clove gave good results.

The treatment of fatty fish and minced fish with antioxidants as a means of increasing the shelf-life during frozen storage has been reported (Bilinski *et. al.*, 1979; Takama *et al.*, 1978; Toyama & Shimazu, 1972; Licciardello *et al.*, 1982). The most common synthetic antioxidants used are butylated hydroxy anisole (BHA) and butylated hydroxy toluene (BHT). These antioxidants provide good protection for the highly unsaturated fats in fish during frozen storage. However, the safety of the synthetic antioxidants has been questioned recently (Imida *et al.*, 1983 and Van Esch, 1986). This has stimulated the evaluation of the effectiveness of naturally occurring compounds as antioxidants. The antioxidant properties of many natural compounds are favoured by the presence of phenolic hydroxyl groups which act as free radical acceptors and in some cases as metal chelators (Harper *et al.*, 1969; Hudson & Lewis, 1983). Clove, cinnamon and pepper have antioxidant properties and the active ingredients present in these are eugenol, cinnamic aldehyde and pinine respectively. Little work has been done to determine the effectiveness of these compounds in fish and fish preparations to extend the shelf-life during frozen storage by reducing the development of off flavour due to oxidation of fat.

The purpose of the present investigation was to evaluate the effectiveness of clove, cinnamon and pepper on incorporation with minced fish to extend shelf-life during frozen storage. Studies were also conducted to evaluate the effect of varying concentrations of spices on the frozen storage characteristics of fish mince.

Materials and Methods

Horse mackerel (*Megalaspis cordyla*) for the experiments were procured in fresh condition from the Fisheries Harbour, Cochin. The fish was iced and brought to the laboratory. Head and viscera were removed, split opened, washed in potable water and meat separated using a meat bone separator. Finely powdered clove (*Caryophyllus aromaticus*), cinnamon bark (*Cinnamonum zeylanicum*) and pepper (*Pepper nigrum*) were added to the minced fish at concentrations of 0.05, 0.1 and 0.2% and mixed uniformly (Table 1.) The spiced minces and control of 300 g each were packed in small waxed duplex carton lined inside with 200 gauge polythene and quick frozen in a contact plate freezer at -40°C. The frozen materials were stored at -20±1°C and samples were drawn periodically for analysis.

The proximate composition of the minced horse mackerel was determined by the method of AOAC (1975). The frozen samples for analysis were thawed by keeping the material sealed in polythene bags in running water for 60-70 min and drained

Table 1. *The amount of spices mixed with minced horse mackerel samples*

Sample No.	Spice	Conc., % to the minced fish
1	Control	-
2	Clove	0.05
3	"	0.10
4	"	0.20
5	Cinnamon	0.05
6	"	0.10
7	"	0.20
8	Pepper	0.05
9	"	0.10
10	"	0.20

over a mesh for 10 min. The peroxide value (PV) was estimated by the method of Lea (1952). The thiobarbituric acid value (TBA) was determined by the method Tarladgis *et al.* (1960). Sensory evaluation of the samples was made in the raw and cooked state by a trained taste panel consisting of 10-12 members. For organoleptic evaluation of the cooked muscle, the minced fish as small balls was cooked in 2% brine for 10 min and presented to the members separately. The hedonic system of scoring was adopted and statistical mean was accepted as the sensory score.

Results and Discussion

Table 2 shows the proximate composition of the fish. Horse mackerel is a medium fatty fish and susceptible to rancidity. The oxidative changes in fat is accelerated by mincing the fish (Grantham, 1982).

The changes in peroxide value during frozen storage of spiced mince samples are given in Table 3. The PV of all the samples increased during frozen storage but the rate

Table 2. *Proximate composition of the minced horse mackerel*

Parameters	%
Moisture	74.88
Protein	20.63
Fat	1.55
Ash	1.38

of increase varied with the spice used as well as its concentration. The rate of development of peroxides was maximum in the control and reached a PV of 72.16 m.eq./kg fat by 36 weeks storage. The increase in PV was lowest in samples incorporated with clove and the rate of peroxidation decreased as the concentration increased. The difference in peroxide values between cinnamon and pepper incorporated samples was insignificant, but addition of cinnamon and pepper had significant effect in retarding peroxidation compared to control. As the concentration of these spices increased the peroxide value showed a decrease.

As seen from Table 4 the the TBA values correlated well with PV in case of mince incorporated with clove and showed significantly lower values compared to control. The TBA values of cinnamon and pepper incorporated minces showed considerably higher values compared to control through out the storage. On 28 weeks storage control and 0.05% cloves, 0.05% cinnamon and 0.05% pepper incorporated minces showed values of 6.30, 3.2, 9.90 and 11.10 mg/kg meat respectively. Also the TBA values did not show any correlation with the concentration of spices in cinnamon and pepper treated samples. In some cases the TBA values increased along with the increase in concentration of these two spices. These discrepancies indicated the possibility of some volatile constituents

Table 3. *Changes in peroxide value (m.eq./kg fat) during storage at - 20°C of spiced mince*

Sample No.	Storage period, weeks						
	0	5	12	20	28	36	50
1	6.82	19.78	32.60	49.80	58.96	72.16	69.38
2	-	4.90	12.70	25.30	36.10	45.20	61.25
3	-	6.43	11.80	17.52	23.46	30.56	43.40
4	-	7.23	9.50	14.20	21.68	27.52	38.18
5	-	9.89	21.30	36.59	45.00	52.08	67.12
6	-	12.61	18.70	26.90	39.86	48.62	62.85
7	-	5.39	12.81	20.32	32.53	41.76	63.60
8	-	14.17	28.32	32.56	37.12	49.28	66.57
9	-	8.47	12.65	28.22	31.00	38.56	52.37
10	-	8.98	14.26	20.97	27.16	36.29	49.92

Table 4 *Changes in TBA values (mg/1000g meat) during storage a -20°C of spiced mince*

Sample No.	Storage period, weeks					
	0	5	12	28	36	50
1	0.546	1.02	2.02	6.30	5.17	8.63
2	-	1.01	1.58	3.20	3.78	6.52
3	0.442	1.53	1.37	2.90	2.76	4.34
4	-	1.06	1.18	2.65	2.4	2.95
5	-	1.66	3.71	9.90	7.81	9.69
6	0.637	4.25	3.48	8.85	5.31	-
7	-	2.57	4.80	7.25	6.73	9.55
8	-	2.47	2.86	11.10	5.57	11.81
9	1.417	3.41	5.86	8.90	7.48	13.16
10	-	3.15	5.01	7.50	6.89	10.06

(may be carbonyls) peresent in these spices interfered with thiobarbituric acid during colour development. In the case of clove the TBA values of samples decreased as the concentration of clove increased and this proportionality maintained through out storage.

Table 5 gives the average sensory score of different mince samples. The clove incorporated samples were preferred by the taste panel compared to all other samples. However, the other two spiced samples were better than the control. The acceptability of the samples did not increase along with concentration. In the clove and pepper incorporated samples, the acceptability decreased as the concentration of the spices increased during the early stages of storage and towards the end of storage the trend reversed and 0.2% spiced samples were found better than 0.05% spice incorporated samples. This reverse in trend of acceptability might be due to the effect of concentration in retarding the development of rancidity. The lower acceptability of spiced minces with higher concentration of cloves and pepper in the mince might be due to

the prominent warm, astringent and slightly bitter flavour of clove and hot, biting and very pungent flavour of pepper during early periods of storage. During the later stages of storage the loss of flavour bearing compounds and the increased retardation of rancidity with concentration of spices might be the cause for better acceptability at higher concentration. The acceptability among various cinnamon treated samples did not vary much with concentration.

It has been found from the results that the effect of different spices on storage stability and acceptability vary considerably among different spices. The strong antioxidant effect of clove may be due to the high amount of eugenol present in it, i.e. 3.03 g/100 g clove (Karmer, 1985). Saito (1977) also reported that the clove has strong antioxidant properties. In the case of clove, a lower concentration (0.05%) is sufficient to enhance the storage, stability and acceptability for about 28 weeks, but for prolonged storage incorporation of 0.1% clove is the most effective. Among the three spices studied cloves has been found more effective than cinnamon and pepper in retarding flavour deterioration.

Tables 5. *Changes in sensory score of spiced mince during storage at -20°C*

Sample No.	Storage period, weeks						
	0	5	12	20	28	36	50
1	7.6± 0.41	7.1± 0.63	5.3± 0.67	4.4± 0.56	3.9± 0.72	3.4± 0.48	-
2	8.1± 0.35	7.8± 0.49	6.6± 1.21	6.3± 0.91	5.6± 0.52	4.5± 0.47	3.6± 0.56
3	7.8± 0.42	7.1± 0.56	5.8± 0.74	5.6± 0.69	4.9± 0.73	4.7± 1.13	4.1± 0.98
4	7.4± 0.61	6.8± 0.73	5.4± 1.28	5.2± 1.09	5.1± 0.65	4.4± 0.96	4.2± 0.82
5	7.9± 0.52	7.6± 0.59	6.7± 1.16	6.2± 0.78	4.8± 1.28	4.6± 0.82	3.4± 0.78
6	8.1± 0.43	7.2± 1.36	5.9± 0.82	5.9± 0.94	5.1± 0.73	4.4± 1.19	3.6± 0.86
7	7.6± 0.27	7.3± 1.19	6.1± 0.54	5.7± 0.82	5.3± 1.22	4.2± 0.53	3.8± 0.67
8	7.8± 0.34	7.2± 0.96	6.3± 1.18	6.1± 1.15	4.9± 0.81	4.3± 0.27	3.6± 0.73
9	7.6± 0.49	6.6± 0.87	5.9± 1.29	5.4± 0.79	5.1± 1.15	4.5± 1.29	3.5± 1.12
10	7.3± 0.59	6.4± 1.21	5.7± 0.89	5.2± 1.16	4.8± 1.26	4.3± 0.72	3.9± 0.86

References

AOAC (1975) *Official Methods of Analysis* (Horwitz, W., Ed.) 12th edn. Association of Official Analytical Chemists, Washington

Bilinski, E., Jonas, R.E.E. & Lau, Y.C.(1979) *J. Fish. Res. Bd Can.* **36**, 219

Grantham, E.J. (1982) *Minced Fish Technology - A Review,* FAO Fish. Tech. Pap. No. 216, FAO Rome

Harper, K.A., Morton, A.D. & Rolef, E.J. (1969) *J.Food Technol.* **4**, 225

Hudson, B.J.F. & Lewis, J.I. (1983) *Food Chem.* **410**, 47

Imida, K., Fukushima, S., Shivai, E.,Ohtani, M., Nakanishi, K. & Ito, N. (1983) *Carcinogenesis,* **4**, 895

Kramer, R.E. (1985) *J.Am. Oil Chem. Soc.* **62**, 111

Lea, C.H. (1952) *J.Sci. Food Agric.* **3**, 586

Licciardellow, J.,Ravisi, M.E. & Allsup, G.M. (1982) *Mar. Fish. Rev.* **44**(8), 15

Saito, Y. (1977) *Abura kagaku,* **26**, 754

Takama, K., Andu, S. & Zama, K. (1978) *Bull. Fac. Fish. Hokkaido Univ.* **29**(1), 56

Tarladgis, B.G. Watts, B.H., Margaret, T.V. & Duncan, L. (1960) *J.Am. Oil Chem. Soc.* **37**,44

Toyama, K. & Shimazu, M. (1972) *Bull. Jap. Soc. Sci. Fish.* **38**, 487

Van Esch, G.J. (1986) *Food Chem. Toxic,* **24**, 1063