RAINBOW TROUT (*SALMO IRIDEUS*) PRODUCED IN FINLAND

VI. Prolongation of the keeping quality rainbow trout by antioxidants

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The transportation of fresh rainbow trout in good condition from the fisher to the consumer or to the fish industry presents a difficult problem. The fat of rainbow trout, like the fat in fish in general, contains plenty of unsaturated fatty acids and turns for that reason very easily rancid. According to HANSEN (1964), the season and the sex of the fish influence the keeping quality of rainbow trout. Treatments that prevent the fish from coming into contact with the air (vacuum, glazing, dipping) have been found to slow down the rate of rancidity in refrigerated and frozen storage (NELSON 1959, BRAMSNAES et al. 1960, BANKS 1961, LILJEMARK 1964, BANKS and HARDY 1965). Chemical preservatives have also often proved effective in protecting fresh fish from turning rancid. BHA, BHT, PG, NDGA which are quite effective in slowing down the rate of rancidity tend to cause minor defects in the taste of the fish (BORENSTEIN 1965, LILJEMARK 1964, LILJEMARK et al. 1959, OLCOTT et al. 1958, OTANI et al. 1954, PISKAREV et al. 1960, TOYAMA 1962). In canned products, BHA has not affected the taste of the fish (TANIKAWA et al. 1960).

The purpose of this study was to test BHA as an antioxidant in the storage of fresh rainbow trout. Ascorbic acid, the synergist of BHA, was also tested in the experiment.

Material and methods

The tested fish consisted of two-year-old male rainbow trouts weighing 300 grams. With the exception of the first experiment, the fish were brought alive to the laboratory, where they were killed, rinsed and filleted. They were then divided into four groups: 1) Control group, 2) 0.02 % BHA, 3) 0.01 % BHA, and 4) ascorbic acid.

The fish fillets were packed in polyethylene bags. BHA, mixed in sunflower oil, was added to the bags. In the fourth group the fish fillets were dipped before packing for 2 minutes in 0.2 per cent ascorbic acid solution. The fish were stored at + 4° C in ice which was changed daily.

Table 1. The effect of different amounts of BHA on the TBA number of rainbow trout during storage (Experiment 1).

	TBA number mg malonaldehyde per 1 gram of fish			
	I	II	III	IV
Control	0.507	1.326	5.109	1.755
0.02 % BHA	—	0.491	0.796	0.601
0.01 % BHA	—	0.678	1.326	1.037

I = April 3, 1968
II = April 8, 1968
III = April 10, 1968
IV = April 17, 1968

Table 2. The effect of preservatives on the TBA number and taste of rainbow trout during storage. (Experiment 2)

	TBA number mg malonaldehyde per 1 gram of fish					Taste scores Scores from 0 to 6		
I	II	III	IV	V	VI	II	III	VI
Control	1.427	8.970	9.670	20.475	20.67	5.0	3.7	2.4
0.02 % BHA	0.608	0.835	0.444	1.731	2.067	4.6	4.3	2.8
0.01 % BHA	0.897	0.991	0.639	4.563	2.847	4.5	4.6	3.1
Ascorbic acid	2.301	4.134	1.014	20.475	8.502	4.0	4.1	3.1

I = April 18, 1968
II = April 19, 1968
III = April 22, 1968
IV = April 23, 1968
V = April 25, 1968
VI = April 29, 1968

Table 3. The effect of preservatives on the TBA number and taste of rainbow trout during storage (Experiment 3).

	TBA number mg malonaldehyde/g fish					Taste scores Scores from 0 to 6				
I	II	III	IV	V	VI	II	III	IV	V	VI
Control	1.575	4.134	4.680	8.268	4.875	4.1	3.1	2.9	2.7	1.8
0.02 % BHA	0.522	0.671	1.014	1.303	0.585	4.2	3.1	3.1	2.7	2.4
0.01 % BHA	0.585	1.037	2.044	1.663	2.517	4.0	3.1	3.2	3.4	2.2
Ascorbic acid	1.794	4.290	5.928	14.118	29.952	3.9	3.1	3.2	2.1	1.2

I = May 5, 1968
II = May 7, 1968
III = May 9, 1968
IV = May 11, 1968
V = May 13, 1968
VI = May 15, 1968

The degree of rancidity of the fish was followed regularly by judging the taste and by determining the TBA number (TARLADGIS et al. 1960). The organoleptic evaluation was performed by the same taste panel and by the same methods as in an earlier experiment (NIINIVAARA et al. 1966). BHA was determined in the beginning and at the end of the experiment by the method of LAZLO et al. (1960).

Results

Tables 1, 2 and 3 reveal the changes both in the TBA numbers and in the taste of the fish in the different experiments.

In all experiments, the amount of malonaldehyde was greatest in the control group, being e.g. in the second experiment as much as 20.5 mg/gram of fish. Fish containing 0.01 and 0.02 per cent of BHA had a longer shelf life judged both chemically and organoleptically. Differences between the two test groups were rather small. The TBA number rose in the ascorbic acid group rapidly and the taste very soon became unpleasant. In the third experiment the taste after one week's storage was worse than in the control group.

The amount of BHA remained stable during the short storage time. This was observed when BHA was quantitatively determined from the fish in groups 2 and 3 during the experiments.

Discussion

In the experiments performed, butylhydroxyanisole (BHA) obviously improved the keeping quality of rainbow trout. Fish containing both 0.01 and 0.02 per cent of BHA were better in quality, judged both organoleptically and chemically, than the control fish and the fish dipped in ascorbic acid for two minutes. BHA did not give an unpleasant taste to the fish.

Determination of TBA proved a suitable indicator of the rate of rancidity. The amount of TBA rose logically in all experiments showing the rancidity before the taste panel were able to discern it organoleptically. For practical purposes the TBA determination is suitable only at the beginning of the storage but not in longer experiments, because the TBA number begins to decrease before the fish is organoleptically judged as spoiled.

Summary

The effect of antioxidants, in the first place BHA, in improving the keeping quality of fresh, gutted rainbow trout was tested in three series of experiments. The fish were packed in polyethylene bags and stored in ice at + 4° C. The freshness of the fish was analyzed by determining the TBA number and by judging the fish organoleptically. In addition, BHA was determined quantitatively in the beginning and at the end of the experiment.

The results indicated that BHA distinctly delayed the rancidity of the fish. Fish stored with 0.01 and 0.02 per cent of BHA remained fresh longer, judged both chemically and organoleptically, than the control fish.

REFERENCES

BANKS, A. 1952. The freezing and cold storage of herrings. Gt. Brit. Dept. Sci. Ind. Research, Food Invest. Spec. Rept. 55, 40 pp. Ref. Fish as Food 4: 371, 1961. New York.

BANKS, A. and K. HARDY 1965. Fat oxidation in relation to the preservation of fatty fish. First International Congress of Food and Technology. Vol. 2. p. 203.

BORENSTEIN, B. 1965. The comparative properties of ascorbic and erythorbic acid. Food Technol. 19: 1719.

BRAMSNAES, F., H. BRENNUM and H. C. SPRENSEN 1960. Antioxidant treatment of rainbow trout. Proc. 10th Internat. Congr. Refrig. 3: 247. New York.
Bull Intern. Ist. Refrig. (Annex) p. 281.

HANSEN, P. 1964. Fat oxidation and storage life of iced trout II. Influence of sex and season. J. Sci. Food Agr. 15 (5): 344—8.

LAZLO, HERTA and DUGAN, L. R. Jr. 1961. A new method for quantitative determ nation of BHA. J. Am. Oil Chemists' Soc. 38: 178—180.

LILJEMARK, A. 1964. Gold storage of retail-packed fillets of mackerel and herring. Food Techn. 18: 380.

LILJEMARK, A., H. W. AAS and MARCUSE, R. 1959. Verbesserung der Haltbarkeit frischer, fetter Fische durch Behandlung mit Antioxydanten. Fette, Seifen, Anstrichmittel 61: 465.

NELSON, R. W. 1959. Keeping rainbows in cold storage. U.S. Trout News. Nov. Dec. Ref. Bull. Inst. Intern. of Refr. No. 5, 1960, p. 1278.

NIINIVAARA, F. P., SIHVOLA, RITVA-LIISA, and LAINE, J. J. 1966. Rainbow trout (*Salmo irideus*) produced in Finland. I. Bacterial spoilage and amino acid composition of fresh rainbow trout during refrigerated storage J. Sci. Agric. Soc. Finland 38: 210—220.

OLCOTT, H. S. and EINSET E. 1958. A weighing method for measuring the induction period, of marine and other oils. J. Am. Oil. Chemists' Soc. 35: 161—162.

OTANI, S., TAKAYANAGI, J. and MATSUHASHI, J. 1953, 1954. Studies on preventing oxidation of fish oils and fish products. I. Effects of butylhydroxy anisole (BHA). Bull. Japan. Soc. Sci. Fisheries 19: 947—951.

PISKAREV, A. J., A. K. KAMINARSKAYA and LUKYANITSA, L. G., 1960. The application of glazing and low temperature in the storage of frozen sprat. Proc. 10th Internat. Congr. Refrig. 3: 243. New York.

TANIKAWA, E., and TERUSHIGE MOTOHIRO 1960. Refrigeration of salmon as the material for canning. Proc. 10th Internat. Congr. Refrig. 3: 80. New York.

TARLADGIS, B. G., WATTS, BETTY M., and YOUNATHAN, MARGARET T. 1960. A distillation method for the quantitative determination of malonaldehyde in rancid foods. J. Am. Oil. Chemists' Soc. 37: 44.

TOYAMA, K. 1962. Relation between the efficiency of antioxidant and degree of unsaturation of substrate oil. J. Tokio Univ. Fisheries 48: 111—118.

SELOSTUS

TUTKIMUKSIA SUOMESSA KASVATETUSTA KIRJOLOHESTA (*SALMO IRIDEUS*)

VI. Antioksidantit kirjolohen säilyvyyden parantajina

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Tutkittiin antioksidantteja, lähinnä BHA:ta, tuoreen peratun kirjolohen säilyvyyden parantajana kolmessa eri koesarjassa. Kaloja säilytettiin jäähileessä polyetyleenipussiin pakattuna + 4°:ssa. Kalojen säilyvyyttä seurattiin TBA-määrityksin sekä makuarvosteluin. Lisäksi suoritettiin BHA-n määritys kokeiden alussa ja lopussa.

Tulokset osoittivat, että BHA hidastaa selvästi kalojen eltaantumista. Sekä 0.01 % että 0.02 % BHA:ta sisältävät kalat säilyivät sekä kemiallisesti että aistinvaraisesti arvostellen kauemmin kuin kontrollikalat.