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PRODUCTION OF SALTED MINCE FROM MULLET AND FRAMES OF RED DRUM AND GROUPER

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INTRODUCTION

The utilization of surplus fish in a salted mince product (4, 6,7,10) has a number of advantages not present in other forms of processed fish. It enables the use of surplus and salvaged flesh, is a rapid process requiring minimal energy inputs and appears to have an already existing market (9). However, a number of obstacles exist which must be overcome before the process becomes a commercial reality.

Availability of suitable quantities of surplus stock, improved control of chemical, physical and microbial changes in the product, maintaining simplicity of manufacture, packaging considerations and market development are problems still requiring additional investigation. A number of these problems have been considered by other workers (3,10,11) and could probably be resolved with existing technology, whereas, others will require additional research.

This is a report on preliminary studies conducted under commercial, pilot plant and laboratory conditions on the production of salted mince from species found in Florida.

MATERIALS AND METHODS

Commercial plant experiments utilized a Bibum, SDX-16 meat-bone separator with 3 mm drum holes. Mixing of mince and salt was in a 25 gal stainless steel paddle type mixer. Brine removal was by hydraulic pressure applied to mince suspended in a nylon bag. Flesh was obtained from frames of red drum and grouper, and butterflied mullet following roe removal.

Pilot plant experiments utilized a Baader, 694 meat-bone separator with 5 mm drum holes, a Hobart mixer and a Chisholm-Ryder Model B1 screw-finisher for brine removal. Laboratory scale samples were prepared in a small Hobart mixer, and brine removal was accomplished with a Buchner funnel. Salted mince was generally prepared by mixing 3 parts flesh with 1 part salt (10) and mixing at low speed for 1 hour. Brine formation was allowed to develop for an additional 30 minutes and then removed by one of the above methods. Modifications of the basic procedure included acidification of the salted mince to pH 4.5 with 6N HCl and/or heating to 80°C for 5 minutes before brine removal. Various materials were added to the mince following brine removal and are listed in the results section. Samples were placed in glass jars and stored at 30°C.

Moisture, lipid and protein were determined according to standard procedures (2). Water activity was measured using an electric Hygrodynamics Hygrometer following standardization with solutions of known vapor pressure. Malonaldehyde was determined according to the method of Yu and Sinnhuber (12) with some modificatins in sample preparation. Aerobic plate counts were by standard procedures with incubation at 35°C (1).

RESULTS AND DISCUSSION

The maximum removal of brine following salting is the major factor governing physical stability of the product during storage. Any step that results in a more complete release of the brine will greatly add to the overall stability of the product. Within the range of moisture contents of the products formulated, Aw varied only slightly and appeared to be governed by the Aw of a saturated salt solution. Table 1 shows the Aw and moistures obtained in preliminary studies. In that there are arguments against addition of expensive chemical humectants and/or a drying step (10), a final product Aw within the range of 0.70-0.75 was considered the best that could be achieved under commercial conditions. This was with the realization that microbial growth can occur within this range but could be controlled by the addition of 0.3% sorbic acid (8).

Table 2 shows data obtained from laboratory and pilot plant prepared salted mince. In an attempt to bring about greater release of the brine, application of heat and/or acidification of the salted mince was investigated. The data show that both of these steps resulted in a reduced moisture content and that a combination of the two treatments resulted in an even greater reduction of the final moisture. The importance of this relates to drip accumulation in the final package. Our data indicated that the final product must have a moisture content of less than 40% before drip is controlled. In an attempt to bind additional moisture, an edible hydrophilic material was added. Coarsely ground corn grits were tested and found to improve water retention. In a number of trials, samples that were heated or acidified containing added grits did not release brine for over six months, whereas, control samples did. This addition of low moisture cereal grains is considered an excellent method for stabilizing brine migration in salted mince produced under commercial conditions. The variability encountered in the data is attributed to differences in raw material as well as to subtle differences in preparation of the product.

When the salted mince is first prepared, the characteristic odor of salt fish is lacking. Depending upon storage conditions, the odor develops in 3 to 7 days and is usually quite mild. The addition of BHT retarded oxidation (Table 3). Concerning species characteristics, both grouper and red drum produced acceptable salted mince. This included characteristics of manufacture and final product. Color and odor as determined subjectively were both considered acceptable. The color varied from light grey to dark yellow. However, mullet flesh presented some problems. Brine release was slow (it formed a gel-like structure when salted), color of the final product was grey and rapidly turned yellow during storage when exposed to air. However, the color stabilized, and the odor was acceptable even when exposed to air for 2 months at ambient temperature. Compositional characteristics of some products are listed in Table 5.

Storage studies of the products (Table 4) indicated that the indigenous microbial flow was not a problem (5) but to insure stability 0.3% sorbic acid should be added (10).

When foods were prepared from stored product, they were acceptable to a small informal panel. Chowder, fish cakes and a mixture of mince and vegetables were considered acceptable to the panel members.

While this work would indicate the feasibility of producing salted mince under commercial conditions, a number of questions still remain. Is pH 4.5 the optimum for maximum brine release and are there additional advantages to be gained from having the mince at a low pH (i.e., microbial suppression) and how will this step affect its physical properties over an extended period of storage? Acidified mince rehydrates readily, however, its color is not as stable as that of heated mince. Heated mince has good physical stability, but its functional properties are altered. That is, it does not rehydrate well, however, is this important from the standpoint of the user? In that this product will probably find its greatest use in institutional feedings, this factor may not be important. In addition, the question of lipid oxidation needs to be answered. Does rancidity need to be controlled and for how long? Current technology is available to solve these problems and only requires an extended storage study combined with sensory work to find an answer. What water binding material to use will be dictated by economics and the end-use of the mince. Soybeans, rice or native starches are all viable options. Finally, additional studies need to be conducted to determine species differences and their effect on product quality.

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	Aw	Moisture
Redfish (Commercial)		
Control	.72	44.40
Control + 2% NFDM	.72	42.78
Control + 1% Tragacanth	.72	43.62
Control + 5% glycerol	.71	42.16
Grouper (Pilot Plant)		
Control	.72	45.90
Control + 20% grits	.72	40.29
Control + 10% glycerol	.71	—
Control + 10% LiCl	.66	—
Corn Grits	.51	8.33
20% glycerol solution	.96	—
Saturated salt solution	.75	—

Table 1. Moisture content and Aw of some salted mince products.

	Aw	Moisture
Grouper (Pilot Plant)		
Control	.75	42.56
Control acidified	.73	40.46
Control heated	.72	24.71
Mullet (Pilot Plant)		
Control	.76	47.09
Control + grits	.76	39.57
Acidified	.77	41.31
Acidified + grits	.78	35.22
Grouper (Laboratory)		
Control	.74	50.54
Heated	.73	40.35
Acidified	.74	48.90
Heated + acidified	.73	36.44

Table 2. Effect of heat and/or acidification on moisture contents and Aw of salted mince.

Treatment	TBA Values week of storage 0	1	2	4	8	12
Grouper (Commercial)						
Control	12.03	23.78	24.97	23.91	22.38	63.55
Control + 20% grits	12.03	16.86	18.71	16.76	17.09	29.06
Control + 100 ppm BHT	6.51	7.19	7.41	6.32	5.94	16.45
Control + 0.3% Sorbic acid	13.00	23.28	25.70	22.65	23.63	24.38
Acidified	16.49	45.70	41.34	36.23	30.04	53.24
Acidified + 20% grits	13.29	33.43	31.51	29.59	27.23	59.05
Acidified + 100 ppm BHT	12.00	28.61	29.52	29.01	21.02	57.68
Acidified + 0.3% Sorbic acid	15.24	43.33	34.65	34.52	34.47	75.40

Table 3. Effect of various treatments on rancidity development in salted minced grouper.

Sample	% Salt In Medium	weeks of storage 0	1	2	4	8	16
Control	A	114,000	910	160	20	40	0
	B	3,000	100	10	0	0	10
Control + grits	A	58,000	1600	200	10	30	10
	B	800	50	10	0	5	0
Control + grits + sorbic acid	A	33,000	700	100	40	50	5
	B	2,700	30	5	0	0	0
Acidified	A	1,300	70	60	30	30	50
	B	400	10	0	0	10	0
Acidified + grits	A	600	100	70	80	60	55
	B	200	20	10	5	20	0
Acidified + grits + sorbic acid	A	500	90	80	30	30	20
	B	200	10	5	5	10	0

A = 0.5% NaCl added to medium
B = 15% NaCl added to medium

Table 4. Microbial changes in salted minced grouper during storage.