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Studies on the reconstitution properties of stored dried spotted spanish mackerel (*Scomberomorus guttatus)*

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Abstract

A study was carried out to compare and evaluate the percentage of reconstitution media (tap water, hot water, 5% NaCl and 5% $Ca(OH)_2$) uptake of stored dried control, irradiated (1 kGy) and heat treated (50 °C) spotted spanish mackerel *Scomberomorus guttatus* at room temperature for 1, 4 and 24 dipping hours upto 180 days of storage period after each 30 days of intervals. Maximum media uptake found in 5% $Ca(OH)_2$ followed by 5% NaCl, hot water and tap water in all samples. The highest (121.81%) and lowest (4.07%) percentage of media uptake observed in $Ca(OH)_2$ and tap water respectively from the irradiated fish sample. This study also reveals that percentage of media uptake depends on reconstitution medias and dipping hours significantly but not with the various samples.

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Introduction

Studies on the reconstitution properties of the dried products showed that less is the shrinkage of the muscle tissue; the better is the reconstitution properties. During drying and also during subsequent storage certain irreversible changes occur which affects the texture and the reconstitution properties of the product. It is also known that dehydrated fish become tougher on storage and loose some of their ability to reconstitute (Conell, 1957). Hence, it is indispensable to achieve a reconstituted food whose characteristics (flavor, texture, color) resemble those of a fresh products and as well as shortening the rehydration time.

Rehydration is the replacement of water in dehydrated foods, but not all products reconstitute to 100% of their original state because of inherent differences in their chemical composition (Vonloesecke, 1955). According to Wang *et al*. (1954), rehydration properties are influenced by six factors which are orientation of muscle fiber with reference to main absorption surface of the samples, thickness, temperature of rehydrating solution, osmotic pressure, pH of rehydrating solution and rehydration under vacuum. Spanish mackerel are marine fish of the Scrombidae family of the Perciformes order, characterized by a long, slender, streamlined body; deeply forked tails; a very narrow portion of body right before the tail; and finlets behind the second dorsal and the anal fins. They provide important commercial, nutritional and ecological values. They are the basis of an important commercial fishery and are key to many marine food chains. As a food fish, fat content varies 28% to 30% and an excellent source of omega-3 fatty acids, which have been shown to reduce the risk of heart disease and other serious illnesses. It is also rich in protein and vitamins D, B_2, B_6, and B_{12}, as well as niacin, copper, iodine, and selenium (Bender and Bender 2005). It also is a source of iron and vitamin B_1. Besides, this species is popular, expensive and available throughout the year in Bangladesh and has good demand to the consumers inside the country as well as in abroad.

The present study was therefore undertake to obtain fundamental data on the reconstitution properties of dehydrated spanish mackerel (*Scomberomorus guttatus)* and to have an interpretation of these results in respect to their quality characteristics.

Materials and methods

Dried mackerel, *Scomberomorus guttatus* (about 15 kg, 58-62 cm long) were collected as raw materials from the trader's godwon, Kawran Bazar, Dhaka. Head and tail were cut-off from the body of about 3-4 cm length and weighing about 6-8 g from different portion of the dried fish were packed in high density polypirol polythene bags sealed by pulse sealer, assigned for three treatments; control, irradiated and heat treated. These were stored in cartoon box for 180 days in room temperature (28±2 °C). Samples were taken separately from control, irradiated and heat treated dried fishes after each 30 days of interval for reconstitution studies. Reconstitute media used for this experiment were tap water, hot water, 5% NaCl and 5% $Ca(OH_2)$. The *p*H of the reconstitution media were determined by the digital *p*H meter and their respective *p*H were 6.8, 7.5, 11.0 and 6.7 for tap water, hot water, 5% NaCl and 5% $Ca(OH)_2$ respectively.

For the experiment, 3 beakers (500 ml) for each reconstitution media were taken, washed, marked and filled with 150 ml of reconstitution media for each beaker. Then two pieces of dried fish from every sample were taken, weighed by electric balance (Denver Instrument Company, AA-1800) and immerged in respective marked beakers. Any loose muscle that attached to sample is removed before dipping in soaking media and was removed after definite intervals of 1:00, 4:00 and 24:00 hours. After removing each sample from the reconstitution media, the surface was blotted with filter paper, reweighed and returned to the respective media in beaker. Experiments were carried out at the room

temperature. The results were expressed as, ml of reconstitution media absorbed per 100 g of dried samples.

Calculation

The percentage of media uptake in rehydrated samples was calculated as follows:

$$\% \text{ media reconstituted} = \frac{W_b - W_a}{W_a} \times 100$$

Weight of the dry fish = W_a,

Weight of dry fish after rehydration = W_b

Media reconstitute = $W_b - W_a$

Results and discussion

It was found that among the different soaking media, maximum absorption occurred in 5% $Ca(OH)_2$ followed by 5% NaCl solution, hot water and tap water respectively (Table 1). Again, the highest (121.81%) media uptake took place in 5% $Ca(OH)_2$ reconstitution media dipping in 24 for irradiated sample and the lowest (4.07%) media uptake took place in tap water dipping in 1 hour for the same sample (Table 1). There were no definite pattern of percentage of media uptake in different storage periods for various samples in different soaking media, rather it fluctuate indiscriminately. But, with the increase of soaking time percentage of media uptake increase in different storage period for all samples as well as in all soaking media (Table 1). This is an agreement with the findings of Saha and Hossain, 2000; who worked with dried sword fish (*Lepturacanthus savala*).

On the other hand, regarding the effects of soaking media, the samples rehydrated in 5% NaCl solution was comparatively tough but attractive in appearance and translucent. While 5% $Ca(OH)_2$ cause softening of the tissue, rendered the reconstituted products slimy and produce bad odor. Due to the presence of divalent ion, the extent of hydration was higher in the samples soaked in $Ca(OH)_2$ solution. According to Wang *et al.* (1954) the highest level of rehydration occurs in Ca-salts, which is in agreement with the present findings.

Besides, initial uptake of hot water was comparatively higher than that of the tap water (Table 1). This is because heat help in easy absorption of water in fish fiber. In both cases, the tendency of absorption increases gradually with the increase of soaking time.

In reconstitution the fiber did not return in addition of water to a state indistinguishable in all respects from that of undried fiber due to the irreversible changes like denaturation of the tissue protein and ultimately decreased its water holding capacity (Decampo and Cutting, 1951). During rehydration of dried fish, water penetration in to the pieces is by diffusion through the protein fibers and not by capillary action (Conell, 1957). The rehydration properties of dry fish are of importance when preparing it for consumption and usually determined by measuring media uptake for a certain time.

Auerbach *et al.* (1954) reported that rehydration apparently depends upon directness and shortness of the water route into the tissue. The less is the shrinkage of the muscle tissue the easier is to reconstitute it but can never regain the original properties of the fresh fish from as dried products suffer some alteration (denaturation) during processing and storage which are irreversible in nature.

On the basis of the experimental results, it is assumed that the uptake of media by the dried fish depends on the nature of reconstitution media and dipping hours but not significantly varied with the treatments (control, irradiation and heat treatment) applied.

Statistical analysis

The statistical analysis showed, tap water from irradiated sample gives most significant result by absorbing soaking media in a consistent rate with the increasing of dipping hours (Table 2). Whereas, in case of hot water, 5% NaCl and 5% $Ca(OH)_2$ control sample gave most significant results than that of other treatments.

Table 1. Percentage of reconstitution media uptake at different storage periods.

Treatment	Reconstitution media	Dipping hours	Percentage (%) of media uptake in different storage period (days)							Avg.
			0	30	60	90	120	150	180	
Control	Tap water	1	11.21	9.23	9.70	9.09	8.63	**7.37**	10.39	**9.37**
		4	23.02	18.15	17.66	14.92	12.96	19.68	19.56	**17.99**
		24	26.92	36.31	31.72	26.14	19.56	**47.62**	34.25	**31.79**
		Average	**20.38**	**21.23**	**19.69**	**16.72**	**13.72**	**24.89**	**21.4**	---
	Hot water	1	**11.35**	13.47	20.78	14.11	16.85	12.53	16.67	**15.11**
		4	18.78	18.38	25.79	18.21	27.31	22.53	25.21	**22.32**
		24	26.91	32.41	30.35	22.65	25.46	**42.79**	28.99	**29.94**
		Average	**19.01**	**21.42**	**25.64**	**18.32**	**23.21**	**25.95**	**26.64**	---
	5% NaCl	1	16.03	15.43	13.02	7.89	6.35	9.92	**5.49**	**10.59**
		4	29.09	23.43	17.96	19.42	13.67	18.39	9.95	**18.84**
		24	38.50	42.43	36.13	29.17	19.90	**46.04**	21.61	**33.39**
		Average	**27.87**	**27.09**	**22.37**	**18.83**	**13.31**	**24.78**	**12.35**	---
	5% $Ca(OH)_2$	1	19.17	14.47	26.19	19.76	16.33	20.87	23.89	**20.09**
		4	47.12	30.28	53.76	45.83	32.67	39.56	49.36	**42.65**
		24	**11.28**	95.22	**120.55**	104.29	71.32	87.58	107.29	**85.36**
		Average	**25.86**	**46.66**	**66.83**	**56.63**	**40.11**	**49.34**	**60.18**	---
Irradiated (1 kGy)	Tap water	1	10.16	6.35	12.78	7.54	**4.07**	9.39	12.09	**8.91**
		4	20.52	13.13	18.32	15.17	11.85	13.75	22.11	**16.41**
		24	28.46	28.26	22.58	24.29	19.91	30.56	**35.12**	**27.03**
		Average	**19.71**	**15.91**	**17.89**	**15.67**	**11.94**	**17.9**	**23.11**	---
	Hot water	1	10.46	13.70	19.04	10.75	**7.17**	12.31	10.45	**11.98**
		4	16.34	19.63	22.55	14.75	12.57	18.16	21.57	**17.94**
		24	25.88	29.015	29.32	23.13	18.60	**40.14**	25.95	**26.58**
		Average	**17.56**	**18.78**	**23.64**	**16.21**	**12.78**	**23.54**	**19.32**	---
	5% NaCl	1	5.79	8.44	12.53	9.30	5.08	**5.81**	5.24	**7.46**
		4	10.85	15.86	20.40	19.13	8.87	9.43	7.51	**13.15**
		24	19.53	32.57	**34.67**	29.58	21.18	27.31	21.45	**26.61**
		Average	**12.06**	**18.96**	**22.53**	**19.34**	**11.71**	**14.18**	**11.4**	---
	5% $Ca(OH)_2$	1	32.82	19.62	26.65	12.48	**9.37**	18.49	19.89	**19.90**
		4	64.86	40.79	48.89	32.92	21.15	30.39	37.26	**39.47**
		24	**121.81**	19.37	117.36	70.29	58.87	108.25	92.13	**82.72**
		Average	**73.16**	**23.59**	**64.3**	**38.56**	**29.79**	**52.38**	**49.76**	---
Heat treated (80 °C)	Tap water	1	20.72	**7.59**	11.30	10.13	15.03	10.03	8.39	
		4	31.35	15.08	19.58	14.97	24.84	20.57	12.76	**19.88**
		24	39.64	33.69	37.41	28.55	37.37	**49.58**	27.58	**36.26**
		Average	**30.57**	**18.79**	**22.76**	**17.88**	**25.75**	**26.73**	**16.24**	---
	Hot water	1	30.93	13.77	15.96	13.36	11.27	**9.88**	12.45	**15.37**
		4	40.68	17.99	22.79	16.01	18.42	17.48	18.89	**21.75**
		24	**44.07**	30.27	32.56	29.81	22.54	34.04	27.71	**31.57**
		Average	**38.56**	**20.68**	**23.77**	**19.73**	**17.41**	**20.47**	**19.68**	---
	5% NaCl	1	12.41	9.99	13.56	9.26	11.22	8.82	**8.41**	**10.52**
		4	20.30	21.38	20.69	21.14	18.67	14.20	13.11	**18.49**
		24	32.70	**48.35**	38.05	34.09	34.51	39.88	26.06	**36.23**
		Average	**21.80**	**26.57**	**24.1**	**21.49**	**21.47**	**20.97**	**15.86**	---
	5% $Ca(OH)_2$	1	16.17	**15.04**	24.35	17.82	27.51	27.54	19.31	**21.11**
		4	36.55	29.42	41.97	42	55.92	48.14	36.83	**41.55**
		24	83.61	93.81	97.24	102.59	96	**112.40**	90	**96.52**
		Average	**45.44**	**46.09**	**54.52**	**54.14**	**59.81**	**62.69**	**48.71**	---

Table 2. Student t-test between different dipping hours and soaking media of control, irradiated and heat treated samples.

Composition	Control	Irradiated	Heat treated
Dipping hours & Tap water	-1.7612455	-1.69111272	-2.4587952
Dipping hours & Hot water	-1.7139405	-2.12634123	-2.3692737
Dipping hours & NaCl	-2.0435153	-2.59423414	-2.4768317
Dipping hours & $Ca(OH)_2$	-1.7739098	-2.12921357	-2.5017243

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