Salting and drying kinetics of brine salted and dry salted Ribbonfish (*Lepturacanthus savala*)

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Drying and salting are the oldest fish preservation techniques. Reduction of water activity (a_w) by salting and drying inhibits the growth of pathogenic and spoilage bacteria, yeasts and fungi, inactivate enzymes and decrease chemical reactions, and thus prolong the shelf life of fish. However, salting techniques, brine concentration and salting period have a direct effect on drying kinetics and characteristic of final products. Ribbonfish (*Lepturacanthus savala*) landed at Visakhapatnam harbour are traditionally salted, sundried and transported to different parts of India. A study was conducted to determine salting and drying kinetics of Ribbonfish during open sun drying.

Fresh Ribbonfish (138.79 ± 31.40 g average weight and overall length 52.50 ± 3.09 cm) were procured from Visakhapatnam fishing harbour and transported to the laboratory in ice. The fresh Ribbonfish had a moisture content of 75.6 ± 0.60%, protein 14.17%, ash 6.66 ± 0.22% and fat content of 3.5% (wet basis). Dry salting (1:4; one part salt to four parts fish) and wet salting of Ribbonfish was carried out in 21% brine solution at ambient temperature. After 24 h of salting, brine salted and dry salted Ribbonfish were sundried at average temperature of 35 °C and average RH of 60%. Samples were drawn at regular interval for analysis of salt and water content.

The rate of salt uptake was not constant for brine salted and dry salted fish (Fig. 1). During the first four hours of salting, for both salting methods, the rate of salt diffusion in the fish flesh was high, although much higher in brine salting. Salt content of fresh Ribbonfish was 0.72 ± 0.02%. After 24 h salting, the salt content increased to 11.17 ± 0.16% and 11.10 ± 0.01% for brining method and dry salting, respectively. However, Figure 2 shows that during the first salting hours (10 h approximately) water content decreased more rapidly in the case of dry salting.

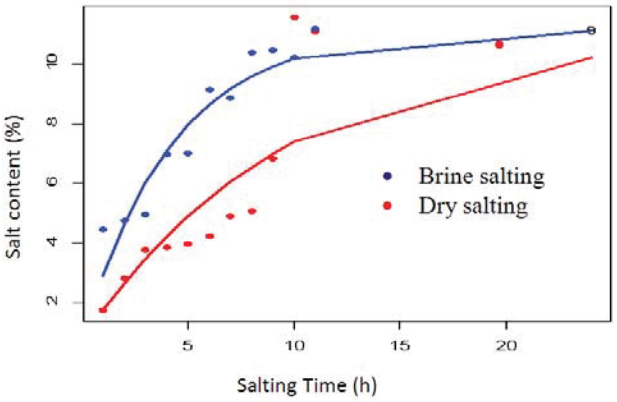

Fig. 1. Effect of salting method on salt diffusion

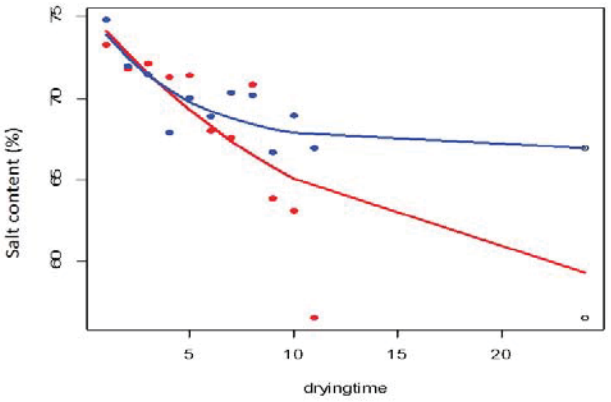

Fig. 2. Effect of salting methods on water content

In order to describe salt uptake, the following equations developed by Zuggaramundi and Lupin (1980) were used:

Salt uptake

$$X_s = X_s^0 exp\ (-k_s t) + X_s^1(1 - \exp(-k_s t)) \qquad (1)$$

Water exudation

$$X_w = X_w^0 \exp(-k_w t) + X_w^1(1 - \exp(-k_w t)) \qquad (2)$$

Table 1. Characteristic values for salting of Ribbonfish

Salting method	Salt diffusion				Water exudation			
	X_s	X_s^1	k_s (h^{-1})	R^2	X_w	X_w^1	k_w (h^{-1})	R^2
Brine salting 21% (w/w)	1.21	11.59	0.21	0.95	75.85	67.70	0.29	0.81
Dry salting (1:4)	0.60	13.80	0.07	0.82	75.26	44.23	0.04	0.90

Where,

X_s= salt content at salting time t, g/g NSSB

X_s^0= initial salt content, g/g NSSB

X_s^1= equilibrium salt content, g/g NSSB

X_w^0= initial water content, g/g NSSB

X_w^1= equilibrium water content for salting period, g/g NSSB

X_w = water content during drying, g/g NSSB

X_w^e= equilibrium water content for drying period, g/g NSSB

(NSSB - non salt solid basis)

k_s= specific rate of salt uptake, h^{-1}

k_w= specific exudation rate, h^{-1}

k_d= specific drying rate, h^{-1}

t= process time, h.

The results indicate that the salting specific constant (k_s) is greater for brine salting which agree with the fact that salt diffusion is higher in this case.

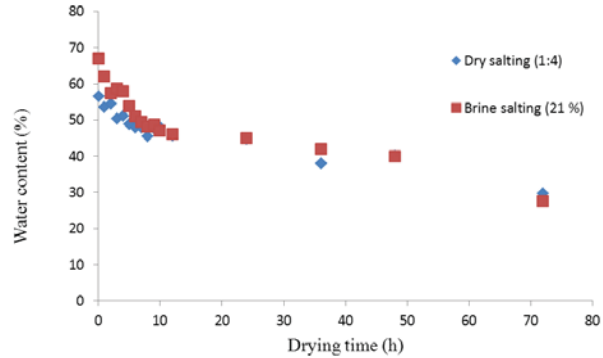

Fig. 3. Experimental drying kinetics of Ribbonfish

After 72 h of drying, moisture content decreased to 27.48 ± 0.46% for brining method, and of 29.65 ± 0.98% for dry salting (Fig. 3). The bacterial load of brine salted Ribbonfish (100 cfu/g) was relatively lower than dry salted Ribbonfish (200 cfu/g). However, the bacterial loads were far lower than that of commercial local sundried Ribbonfish (9800 cfu/g).