Heat Coagulation Studies on Mixed Systems of Actomyosin and Sarcoplasmic Protein

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Actomyosin and sarcoplasmic proteins were prepared from fishes like oil sardine *(Sardinella longiceps)* mackerel *(Rastrelliger kanagurta)* mullet *(Mugil parsia)* cat fish *(Tachysurus dussumeri)* tilapia *(Tilapia mossambica)* and poolan *(Electris fusca)* by extracting with appropriate buffers. They were heat coagulated individually and also after mixing in various proportion. The ratio of actomyosin to sarcoplasmic protein varied from 0.28 to 1.2 while the ratio of actomyosin to coagulable sarcoplasmic protein varied from 0.82 to 2.0. On heating after mixing sarcoplasmic protein and actomyosin in various proportion; it is the actomyosin that is mostly affected compared to sarcoplasmic protein. These observations may have a direct bearing on the gel forming capacity of the meats of the concerned species.

Interaction between actomyosin and sarcoplasmic protein of horse mackerel muscle during heat coagulation has been studied by Yutaki Shimizu & Fujio Nishioka (1974a). Species variation in heat coagulation of fish actomyosin and sarcoplasmic protein has been studied by the same authors (1974b). Gel forming capacity of washed and unwashed flesh of some Pacific coast species of fish has been studied by Kudo George *et al.* (1973). Effect of heat processing on extractibility of salt soluble protein, tissue binding strength and cooking loss in poultry meat has been studied by Acton (1972). However, heat coagulation studies on mixed systems of sarcoplasmic protein and actomyosin has not been reported in tropical fishes. This paper presents results of such a study on six species of tropical fishes.

Materials and Methods

Fishes used in this study were obtained fresh from the local market, gutted on arrival at the laboratory and the flesh alone was used for the extraction. Extraction was done as described by Yutaki Shimizu & Fujio Nishioka (1974b). Heat coagulation was carried out at 70°C for 30 min. Sarcoplasmic protein and actomyosin were mixed in the ratio of 20:0, 16:4, 12:8, 10:10, 8:12, 4:16 and 0:20. The protein nitrogen content in all cases were determined by micro Kjeldahl's method (Hawk, 1954).

Results and Discussion

The content of sarcoplasmic protein nitrogen, actomyosin nitrogen, coagulable sarcoplasmic protein nitrogen, ratio of actomyosin nitrogen to sarcoplasmic protein nitrogen and actomyosin nitrogen to coagulable sarcoplasmic protein nitrogen of tilapia, sardine, mackerel, cat fish, poolan and mullet are given in Table 1. Sarcoplasmic protein content was in the order tilapia < poolan < catfish < sardine < mullet and < mackerel whereas coagulable sarcoplasmic protein content was in the order of poolan < mullet < mackerel < cat fish < tilapia and < sardine. The ratio of actomyosin to coagulable sarcoplasmic protein increased in the order sardine, mullet, cat fish, poolan, tilapia and mackerel. This variation in the ratios seemed to be closely related to the gel forming capacity of their meat, as observed by Yutaki Shimizu & Fujio Nishioka (1974b). Higher this ratio greater will be the gel forming capacity. This is significant and has got wide applications, especially in preparing Kamabako type of product where the gel forming capacity is a very important factor. The variation in the sarcoplasmic protein can be related to the swimming activity of fish. Mackerel and sardine having more red meat have higher sarcoplasmic protein content and greater swimming activity (Anon, 1966) when compared to the other fishes studied here. Tilapia is an exception which may be due to the fact that it is a fresh water fish.

Effect of mixing actomyosin and sarcoplasmic protein in various proportion on heat coagulation is given in Table 2. In all the cases studied, the protein remaining in solution after heat coagulation is decreasing when the content of actomyosin in the mixed system is increased, showing that it is mainly the actomyosin which is affected by heating. Such an observation has been reported by Hamm (1966). According to him when sarcoplasmic protein and myofibrillar protein are denatured during heating of meat, the extent of denaturation depends on the temperature attained. The variation in the value for the protein remaining in solution can be due to individual variation in the sarcoplasmic and actomyosin fractions of the various fishes.

Table 1. *Contents of sacroplasmic protein nitrogen (A), coagulable sarcoplasmic protein nitrogen (B), actomyosin nitrogen (C) and the ratio of C/A and C/B in various fishes*

Name of fish	A mg/100g	B mg/100g	C* mg/100g	C/A	C/B
Tilapia	627.2	397.7	753.8	1.20	1.89
Poolan	638.4	134.4	220.4	0.35	1.64
Cat fish	840.0	397.5	600.0	0.71	1.51
Sardine	974.5	501.3	412.5	0.42	0.82
Mullet	1064.0	229.5	295.0	0.28	1.29
Mackerel	1332.0	340.7	684.0	0.51	2.00

*C is taken as the difference between muscle soluble in buffer of ionic strength 0.6 and 0.1

Table 2. *Effect of mixing sarcoplasmic protein (sp) and actomyosin (am) in various proportion on heat coagulation*

Mixing ratio sp:am	Protein nitrogen remaining in solution in 20 ml after heat coagulation in mg/100g					
	Tilapia	Sardine	Catfish	Poolan	Mackerel	Mullet
20:0	71.34	68.57	10.53	7.90	21.75	15.68
16:4	53.89	60.60	8.86	5.83	20.01	11.76
12:8	51.24	55.09	7.57	5.62	17.78	10.22
10:10	—	—	6.48	6.29	—	—
8:12	43.79	51.09	5.88	4.79	15.24	9.37
4:16	38.93	44.82	5.18	4.37	12.26	8.85
0:20	37.87	42.36	4.74	4.63	10.83	7.39

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