Use of Tripolyphosphate in the Development of Products from Minced Fish Meat

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Sodium tripolyphosphate can be used with several advantages in dried products prepared from minced fish. It lowers the water activity (^{a}w) of the product and has got bactericidal property. It increases hydration of the protein and increases resistance to thermal denaturation of the protein.

In India, we face the problem of under utilization of deep sea bycatches leading to the uneconomical commercial fishing. Besides few commercially important species, most of the newly landed species, find less acceptability with the consumer due to nonfamiliarity. Development of acceptable products from minced meat obtained from these species may solve the problem of non acceptability thereby fetching good remuneration for landing from deep sea trawlers and finding a solution to protein malnutrition.

Basu *et al.* (1985) developed fish cube, dried fish cake from raw minced meat. The product contains 11–12.5% moisture and has four months shelf life. The product has got tough texture. It was felt necessary to find out some chemical which will improve the texture and shelf life of such products. The possibility of use of sodium tripolyphosphate for the purpose is described in this paper.

Materials and Methods

Minced meat from sciaenid was obtained by passing fillets through meat mincer. Minced meat was mixed thoroughly with 0 4 and 0.7% sodium tripolyphosphate and dried in sun upto 50% moisture in the form of small cakes (1.5 x 1.5 x 0.5 cm size). Cakes were also prepared with minced meat where no polyphosphate was used. Water activity of the cakes was measured by equilibrating the samples at different RH (Stockes & Robenson, 1947) and measuring percent equilibrium moisture content at a particular temperature by isopiestic method (Bull & Breese, 1970; Chattoraj & Mitra, 1977). The samples were equilibrated for 48 h and moisture content of equilibrated samples were determined by AOAC (1975) method.

Minced meat from sciaenid was mixed thoroughly with 0.2, 0.4, 0.7 and 1.0% sodium tripolyphosphate and kept for 1.5 h at room temperature (30°C). Total bacterial count of all the polyphosphate treated samples along with blank was determined by standard pour plate method using tryptone glucose agar medium.

Actomyosin from fish muscle was prepared following the method of Herring *et al.* (1969). Specific viscosity of actomyosin solution was measured by Ostwald viscometer at temperatures ranging from 28 to 50°C dipped in a specially designed thermostatic bath attached with insulated cover. Servo - therm oil was used in the bath. The temperature of the bath could be adjusted within ± 0.01°C. Fifteen minutes time was allowed for the solution to attain the bath temperature.

Flow time (t) of 5 ml atomyosin solution at different temperatures was noted. Flow time for the blank at different temperatures is represented as t_o. Specific viscosity (η_{sp}) at a given temperature was then calculated based on the equation:

$$\eta_{sp} = \frac{t - t_o}{t_o}$$

For each protein solution in different salt solution (0.6 M NaCl solution and 5% sodium tripolyphosphate solution) η_{sp}/C was plotted against temperature so that a melting profile of fish actomyosin in each case was obtained.

Results and Discussion

Fig. 1 shows the plot of percent equilibrium moisture content against water activity (a_w) of fish cakes treated with 0.4 and 0.7% sodium tripolyphosphate and also of control where no polyphosphate has been used. It is clear from the figure that sodium tripolyphosphate reduces the a_w of the product and as concentration increases, the a_w further decreases. At a particular equilibrium moisture content, say 15% the control cake shows a_w of 0.804, the cake with 0.4% tripolyphosphate 0.776 and that with 0.7% tripolyphosphate 0.75. So it can be concluded that sodium tripolyphosphate acts as an agent for reducing water activity. Reduced a_w will allow more moisture content in the product with consequent less toughness and longer shelf life.

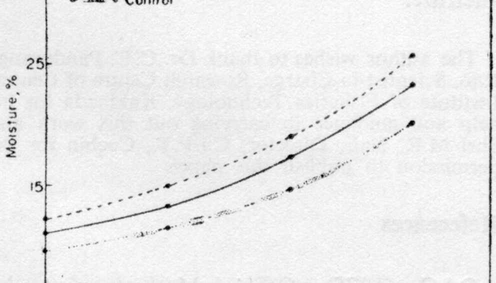

Fig. 1. Plot of equilibrium moisture content against water activity of fish cake.

Table 1 shows the total bacterial count of minced meat samples treated with different concentrations of sodium tripolyphosphate and also of control. Treated sample showed less bacterial count as compared to control. As the concentration of tripolyphosphate increased, the total bacterial count decreased gradually, showing bactericidal property of sodium tripolyphosphate. This property will ensure longer shelf life of the product. Fig. 2 shows the hydration characteristics in terms of percentage of water absorbed at equilibrium at different RH of dried fish cakes treated and not treated with sodium tripolyphosphate. For both samples the percent equilibrium moisture content is very low below 80% RH. Above 90% RH, equilibrium moisture content for treated sample is very high whereas the value for the untreated control is very low. This shows that rehydration of the dehydrated product where tripolyphosphate has been used will lead to good hydration of the protein giving a product with less toughness and good juicines.

Table 1. *Total bacterial count in presence of different concentrations of sodium tripolyphosphate*

Sodium tripolyphosphate concentration, %	Total bacterial count/g *
Nil (control)	1.3×10^4
0.2	1.1×10^4
0.4	9.3×10^3
0.7	6.2×10^3
1.0	2.0×10^3

* Average of three replicates

Thermal transition (denaturation) of fish actomyosin in presence of 0.6 M NaCl and 5% sodium tripolyphosphate are presented in Fig. 3 in the form of η_{sp}/C against temperature. Several authors (Mitra & Chatterjaj, 1978; Stainsby, 1958; Hamaguchi & Geiduscehk, 1962; Von Hipple & Schelich, 1969; Tonomura *et al.*, 1962) have studied the thermal transition of proteins and nucleic acids by measuring η_{sp}/C as a function of temperature. For globular protein thermal transition is known to be accompanied by a sharp increase of η_{sp}/C in a very narrow range of temperature. But, for elongated molecule, thermal transition is accompanied by a sharp fall in viscosity and hence η_{sp}/C. So for thermal transition study, it is logical to take the region of sharp fall of η_{sp}/C as the melting region. Melting temperature in such cases can be taken as the mid point of the transition region. Also for

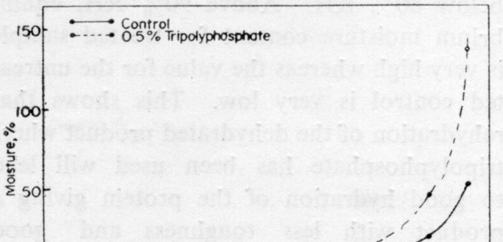

Fig. 2. Plot of equilibrium moisture content against relative humidity of fish cake.

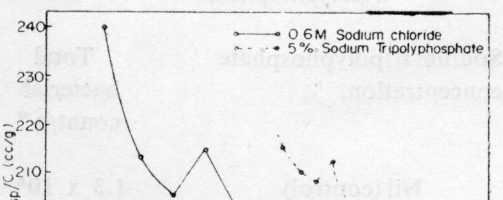

Fig. 3. Plot of η_{sp}/C against temperature of actomyosin in 0.6 M NaCl and 5% sodium tripolyphosphate. Actomyosin content in both the cases is 0.002 g/ml.

globular protein the mid point of sharp rise region of η_{sp}/C is taken to point out melting temperature (Chattoraj & Mitra, 1977). In this case there are two sharp falls in η_{sp}/C. The two falls possibly indicate the thermal transition of two fraction, one for actin and another for myosin. The intermediate rise may be possibly due to the trace amount of globular fraction of actin (Fribarg, 1976). However from these data it is not possible to identify which particular fall is due to a particular fraction. It is also seen that the middle of the up transition region is the average of the two extreme transition region. Hence it seems logical to denote this particular point as the melting temperature of the composite protein actomyosin. From Fig. 3 it is seen that denaturation temperature of fish actomyosin in presence of 0.6 M NaCl is 36.8°C whereas in presence of 3% sodium tripolyphosphate, denaturation temperature is 45°C. So use of sodium tripolyphosphate in fish cake will resist thermal denaturation upto 45°C. This will give a product with less toughness.

So a single chemical, sodium tripolyphosphate, reduces the water activity, acts as bactericidal agent, improves hydration of protein and resists thermal denaturation upto 45°C. So this chemical can be used advantageously to develop dried products like fish cake from minced fish meat with good texture (less toughness) and longer shelflife.

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