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INFLUENCE OF SALT CONCENTRATION AND TEMPERATURE ON LAMB PROTEIN EXTRACTABILITY

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OBJECTIVES

The salting and partial drying of minced lamb, stable under tropical conditions, has been suggested as a feasible technology for the production, storage and distribution of preserved meat within rural communities in Ceara, Brazil (Zapata et al. 1990). In general, a 25 percent salt concentration (w/w salt to meat) is used to enhance the release of excess fluid during the preliminary stages of processing by a salting out mechanism prior to the drying stage. However, little information is available on how efficient this salting out process is, or on its effect on losses of soluble protein in the press fluid prior to drying.

The aim of this study was to establish the influence of salt concentration and temperature on the extractability of muscle proteins from homogenised lamb and thereby assess the likely importance of these variables to the efficiency of this processing technology.

MATERIALS AND METHODS

Freshly chilled lamb was obtained within 24 h of slaughter and the lean musculature dissected from the leg joints and minced. 10 g samples were then homogenised with 190 ml of sodium chloride solutions at the following concentrations: 0 M, 1 M, 2 M, 3 M, 4 M, 5 M and 6 M. The suspensions were placed in shaking water baths set at different temperatures (0°C, 10°C, 20°C, 30°C, 40°C and 50°C) for 1 h. The pH values of the suspensions were recorded at the start and at the end of each incubation period, after which they were centrifuged at 12000 g for 30 min. A 30 ml aliquot of each supernatant was then removed for protein quantification by the Kjeldahl method for total nitrogen (AOAC, 1980). Another 10 ml aliquot of each supernatant was removed for protein analysis by SDS-PAGE. Each aliquot was dialysed against several changes of distilled water over a 16 h period at 0°C. 1 ml of each dialysed solution was added to 1 ml of two x sample buffer (20 mM Tris/HCl and 2 mM EDTA pH 8.0 containing 5% SDS, 10% -mercaptoethanol and 0.02% bromophenol blue). Each sample was then heated at 100°C for 5 min, cooled rapidly and a 2 µl sample applied to a 12.5% homogeneous PhastGel. Separation and tentative identification of the proteins was carried out using a Pharmacia LKB PhastGel System. The gels were subsequently developed using the PhastGel development unit with coomassie blue R as the staining dye. All extractions and analyses were repeated in duplicate and the results expressed as mean values.

RESULTS

From Table 1, it can be seen that at all temperatures, protein extraction was greatest in 1.0 M salt solution, as would be expected (Bard, 1965; Offer and Trinick,1983). Thereafter, extractability progressively decreased by a factor of approximately three as salt concentration reached 5.0 and 6.0 M, marginally higher than that observed in the pure water control.

Table 1. Mean values for protein extractability (mgN/ml) for lamb homogenates as a function of temperature and salt concentration.

Salt Concentration M	Extraction Temperature 0°C	10°C	20°C	30°C	40°C	50°C	Mean
0.0	0.36	0.37	0.35	0.35	0.34	0.35	0.35
1.0	1.21	1.00	1.03	1.15	1.06	0.69	1.02
2.0	0.96	0.93	0.87	0.87	0.63	0.52	0.80
3.0	0.71	0.67	0.61	0.64	0.60	0.46	0.61
4.0	0.58	0.56	0.47	0.57	0.46	0.48	0.52
5.0	0.45	0.47	0.53	0.48	0.40	0.45	0.46
6.0	0.44	0.41	0.49	0.44	0.43	0.42	0.44
Mean	0.67	0.63	0.62	0.64	0.56	0.48	

Temperature had a less consistent effect on protein extractability throughout the range of salt concentrations investigated. However, extractability decreased substantially in the 1.0, 2.0, and 3.0 M salt solutions as the extraction temperature increased

from 40°C to 50°C. In contrast, increasing the temperature had little effect on the control samples and those extracted in 4.0, 5.0 and 6.0 M NaCl.

The pH values of the various homogenates generally increased by 0.10 pH units over the extraction period at all temperatures from 0°C to 40°C, and by approximately 0.20 pH units at 50°C. In contrast, salt concentration resulted in an overall decrease in pH from around pH 6.20 in the controls to pH 5.65 in the 6.0 M homogenates.

SDS-PAGE of dialysed extracts confirmed the pattern of protein extractability. In the 0 M salt extracts, thirteen sarcoplasmic protein bands, ranging in molecular weight from 66 kD to 14.5 kD were clearly visible. The predominant components were serum albumin (66 kD), two protein bands of 50 kD and 40 kD respectively, and myoglobin (17 kD). The intensities of the 66 kD, 50 kD and 17 kD bands decreased in the 1 M, 2 M, and 3 M salt extracts, particularly at 0°C, before increasing again in the 6 M extract.

The presence of myofibrillar proteins was seen in the 1 M, 2 M and 3 M extracts at all temperatures from 0°C to 50°C. These included the dense high MW band of 205 kD (myosin) and minor components of 148 kD, 100 kD, 38 kD, 30.5 kD and 21 kD. The 205 kD and 38 kD components were also detectable in the 4 M, 5 M and 6 M salt extracts. At 50°C, however, thermal denaturation inhibited the extraction of myofibrillar proteins in the 2 M and 3 M salt solutions, although the 205 kD and 38 kD components were clearly present in the higher salt concentration extracts. In contrast, this higher temperature had little effect on the pattern of sarcoplasmic proteins seen in these gels.

CONCLUSIONS

1. Sarcoplasmic proteins are soluble at all salt concentrations up to 6M, irrespective of extraction temperature from 0°C to 50°C.
2. Myofibrillar proteins are predominantly soluble at salt concentrations of 1 M and 2 M and to a lesser extent at 3 M, but at temperatures of 40°C, and particularly 50°C, the extent of solubility at these salt concentrations decreases substantially.
3. Irrespective of extraction temperature, the 205 kD and 38 kD myofibrillar components remain partially soluble at all salt concentrations above 3 M.
4. It is recommended that 4 M, 5 M or 6 M salt concentrations may be used at temperatures of 40°C to 50°C to minimise protein losses during lamb preservation by the salting/drying process.

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