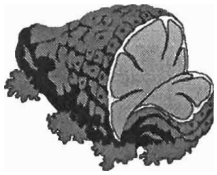

Meat Processing

Manipulating brine addition to improve water binding and textural characteristics of cooked, restructured beef rolls

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Introduction

Adequate binding of processed meats, as related to both the adhesion of meat particles and water holding by the meat proteins, relies on proper extraction of myofibrillar proteins from the meat. This is often achieved by tumbling or massaging. One of the primary functions of these processes is to disrupt the normal muscle structure by the application of mechanical energy in the presence of a brine solution which helps to extract the salt-soluble proteins and enhance the binding of water within the muscle. An increased tissue disruption allows increased protein extractability, results in more solubilization of muscle proteins and, thus, an increase in the cook yield of the products.

Tumbling can also be an important process which facilitates the restructuring of meat pieces into a value-added final product. Restructured lean roast beef products represent a potential growth area for the beef industry due to their lower cost, low-fat content and convenience. The utilization of restructured meat technology could lead to an increase in the utilization of lower price cuts as well as increasing the value-added beef products available at retail.

Many processors have found that optimizing tumbling regimes for beef is more difficult than for other meats such as pork or poultry, and this could be due, in part, to the greater amount of connective tissue in beef and its fibrous structure. Greater protein extraction can be achieved at higher ionic strength (salt concentration) with a maximum near 8% salt, however, the amount of added salt in processed meats must be kept low for palatability reasons. Few studies have evaluated the effects of temporarily increasing ionic strength in roast beef production. In addition, little information is available on the effect of incremental brine/water addition during the tumbling process on binding and textural characteristics of restructured beef rolls produced with high levels of water addition. The combination of rate with quantity of brine component addition during the tumbling process may provide a useful means of improving the textural and binding properties of beef.

The objective of this study was to determine the combined effect of time and quantity of water /brine ingredients (salts) addition on quality characteristics of restructured beef rolls processed with 25 or 50% pump level (i.e. 25 or 50 kgs of brine added to each 100 kg of meat).

Methods

Using inside round (*Semimembranosus*), beef rolls were formulated to contain 1.8% sodium chloride and 0.3% sodium tripolyphosphate. Within each pump level, the tumbling treatments were:

- all the brine added at the beginning of the tumbling (1xB)
- half of the brine added at the beginning and half after 2 h of tumbling (2xB)
  quarter of the brine added at the beginning and the remaining brine after every hour of tumbling (4xB)
  all the salts with half of water added at the beginning and remaining water after 2 h of tumbling (B+W)
  all the salts with a quarter of water added at the beginning and the remaining water after every hour of tumbling (B+3xW).

All treatments were intermittently vacuum tumbled for 4 hours (20 min. on, 10 min. off) at –0.8 atm pressure and then rolls were cooked in a water bath to a final internal temperature of 72°C. Hydration properties (cook yield, expressible moisture, purge

during storage of vacuum packaged slices) and textural characteristics (bind strength, texture profile analysis) of beef rolls were determined.

Results

The results of this research indicate that the timing of water addition is critical to ensuring good binding and textural characteristics of cooked beef rolls (Table 1). Brine addition of 50% had detrimental effects on product water binding and textural characteristics. These high added water treatments produced rolls that were less hard, less chewy, and less cohesive, and had poorer binding properties than rolls produced with lower water content. A number of factors, such as differences in meat to liquid component ratio and, thus, in friction between meat particles, ability of the meat to absorb brine/water, the extent of protein extraction, may be involved and could adversely affect the hydration properties in these formulations. The loss in functionality by higher water addition was not overcome by the tumbling treatments.

Addition of brine in two parts favorably affected hydration properties and thermal stability of beef rolls, yielding lower cooking loss and purge, and higher water holding capacity for both pump levels. It also increased hardness, but was unable to substantially improve bind, cohesiveness, or springiness.

One very interesting finding was that late addition of water during tumbling (B+3xW) adversely affected textural characteristics, which resulted in rolls that were less hard, less springy, less cohesive, and less chewy, and had poorer water binding properties than any other treatment. These results may have been due to insufficient tumbling time after addition of last portion of brine/water, and to the fact that brine/water was added too late in the processing to be integrated into the meat protein gel structure. If all or half of the brine was added at the beginning of the tumbling, sufficient time was available for the absorption of the added water. However, when the last portion of water/brine was added one hour before the end of tumbling, the added water, although absorbed initially in the raw state, it was not retained in the cooked product. In this situation it is possible that a portion of the water remained loosely bound in the exudates, rather than being fully absorbed into the meat pieces, despite the fact that in all treatments the added water was successfully absorbed into the meat mixture, and no substantial differences in appearance among the tumbling treatments were observed at the end of processing.

In summary, a longer tumbling time after addition of brine/water or addition of brine in two parts provided more favorable conditions for incorporation of the water/brine into the muscle cells so that the added water was retained both in the raw and cooked state, thereby improving yield and textural properties of restructured beef rolls.

Acknowledgements

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Table 1. Water binding properties, bind strength and Texture Profile Analysis (TPA) parameters of beef rolls as influenced by timing and quantity of brine addition.

	Cooking loss [%]	Expressible Moisture [%]	Purge [%]	Bind [N]	TPA Hardness [N]	TPA Springiness [cm]	TPA Cohesiveness [-]	TPA Chewiness [N*cm]	
			1 week	3 weeks					
Treatments									
1xB	14.31b	30.11a	3.67a	6.78a	14.34a	294.4b	0.741a	0.527ab	117.9b
2xB	11.71c	28.14b	3.23b	6.07b	15.43a	325.2a	0.742a	0.538a	133.0a
4xB	13.50b	31.25a	3.55a	6.57ab	13.79ab	291.7b	0.735ab	0.536a	118.4b
B+W	13.21b	29.87ab	3.60a	6.58a	14.47a	299.5b	0.741a	0.527ab	121.0b
B+3xW	16.06a	30.13a	3.52a	6.49ab	12.52b	259.7c	0.722b	0.508b	99.3c
P	0.000	0.017	0.001	0.003	0.000	0.000	0.006	0.001	0.000
Brine level									
25%	9.51	25.68	3.01	5.59	18.72	368.5	0.766	0.555	157.4
50%	18.00	34.12	4.02	7.41	9.50	219.7	0.706	0.499	78.4
P	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

a-c, Means within a column followed by different letters are significantly different ($P<0.05$)