Effect of electrically stimulated meat on processing properties of cooked sausage

R. TUOMINEN and M. HONKAVAARA

Finnish Meat Research Centre, Hämeenlinna, Finland.

Introduction

Many independent studies carried out over the past few years have shown that either low or high voltage electrical stimulation of beef carcasses makes it possible to prevent cold shortening that results from cooling meat too rapidly and to make the tenderization of meat faster and more reliable (2). High-voltage stimulation has also been shown to affect the formation of a heat ring and the occurrence of marbling.

In addition to these effects, which are beneficial with respect to the utilization of valuable muscle, it is also important to know the effects of electrical stimulation on less valuable muscle and hence on meat products.

The purpose of this study was to investigate the effect of low-voltage stimulation on the binding properties of the beef cuts used in sausage preparation and on the quality of the cooked sausage produced.

Material and methods

The material used in this study was obtained from an abattoir with electrical stimulation equipment. Stimulation was carried out after exsanguination by passing a current through the carcass via clamps attached to the animals' nostrils as they hang above a bleeding through. The voltage was 80 V, the frequency 1 Hz and the stimulation time 60 seconds (1).

The pH of the carcasses was measured by means of an electrode inserted between the 7^{th} and 8^{th} ribs about 1 hour after stunning (pH_1), after shock freezing (pH_4) and on the following day in the carcass storage (pH_{24}). The subscripts 1, 4 and 24 indicate the time in hours that elapsed between slaughtering and carrying our the measurements.

The binding capacity of hind knuckle-breast mixtures (weight c. 200 g) from 19 stimulated and 19 non-stimulated beef cattle was determined at the abattoir (3). For the preparation of cooked sausage a total of ten pieces of meat weighing c. 3 kg each and comprising three oysters, one breast and one chuck were cut from stimulated and non-stimulated meat taken from bulls with classifications as close to one another as possible. Each cut was used for binding capacity determination (4) and then to prepare a series of cooked sausages containing various amounts of water (Table 1).

Table 1. Recipe for the cooked sausage emulsion, and the amounts of water added.

	%				%	
beef	37,2		salt		2,1	
pork fat	14,5		phosphate		0,23	
water	see below[1]		nitrite		0,15	
dried milk	4,1		robiol		0,21	
potato flour	6,2		spices		0,21	
[1] Added water, %	34,4	37,4	40,3	43,3	46,2	50,2

The fat content of the non-precured cuts were made constant prior to preparation of the cooked sausage. The sausages were prepared four days after slaughtering the bulls. Additives were mixed into the emulsion along with the added water. Each batch of sausage contained the same amount of beef. Five series, each consisting of six sausages, were prepared using different amounts of water from both stimulated and non-stimulated beef. The final consistency of the sausages was measured using an Instron consistometer.

Results and discussion

1. Binding by beef

There was no significant difference in water binding between the stimulated and non-stimulated bovine hind knuckle-breast mixtures. However, the hind knuckle-breast mixture prepared using stimulated meat from cows showed significantly better binding than the equivalent mixture from bulls. The fattier the meat taken from the cow, the better its binding capacity, which is probably due to the type of protein and marbling of the fat rather than to the electrical stimulation. The time elapsed between stunning and cutting the meat (one hour or two days) had no significant effect on the binding capacity of the mixture prepared from stimulated meat. The hind knuckle-breast mixture prepared from cows whose meat was stimulated after evisceration showed significantly better binding capacity than the corresponding mixture prepared from cows whose meat was stimulated in conjunction with exsanguination. Stimulation caused decreases in water-binding capacity of 4,4 % in oyster, 21,4 % in chuck and 15,8 % in breast (Table 2). The average decrease in water-binding brought about by stimulation was 15,2 % and in fat emulsification 2,4 %.

Table 2. Effect of stimulation on water binding (SV) and fat emulsifying (SR) in beef.

Meat	SV %	SR %
non-stimulated oyster	68	90
" "	67	87
" "	18	18
" chuck	42	54
" breast	19	43
stimulated oyster	47	80
" "	66	86
" "	27	43
" chuck	33	62
" breast	16	30

The theoretical water-binding value (%) of stimulated and non-stimulated beef was calculated from the consistency measurements (Fig. 1) and the series of cooked sausages containing different amounts of added water and prepared from the meats given in Table 3. A value of 70 % was obtained for stimulated beef and 80 % for non-stimulated beef. According to this, the use of additives such as phosphate does not prevent the decrease in binding brought about by the fall in the pH value of stimulated meat.

2. Quality of cooked sausage

The chemical composition of the cooked sausages prepared from breast, chuck and three oysters taken from both stimulated and non-stimulated bulls is shown in Table 3.

Table 3. Chemical composition of cooked sausages prepared from emulsion without the addition of water.

Meat	water %	protein %	fat %	salt %
non-stimulated oyster	65,0	10,0	16,1	2,5
" "	64,1	10,0	17,0	2,5
" "	63,0	10,4	-	2,4
" chuck	61,9	9,7	-	2,4
" breast	62,1	9,7	-	2,4
stimulated oyster	64,4	10,2	16,4	2,4
" "	64,4	10,6	16,4	2,5
" "	63,6	10,7	-	2,4
" chuck	61,3	9,5	-	2,4
" breast	61,6	9,8	-	2,4

The chemical composition of cooked sausages prepared from the same cuts of stimulated and non-stimulated meat is roughly the same. Sensory evaluation failed to show any differences in binding, though sausages prepared from stimulated meat were found to have a greyer colour than those prepared from non-stimulated meat.

The effect of the amount of water added to sausages prepared from stimulated and non-stimulated beef on consistency is shown in Fig. 1. In sausages prepared from non-stimulated meat the amount of water corresponding to acceptable consistency (1,2 kp) was 1,9 percentage points higher than for sausage prepared from stimulated meat.

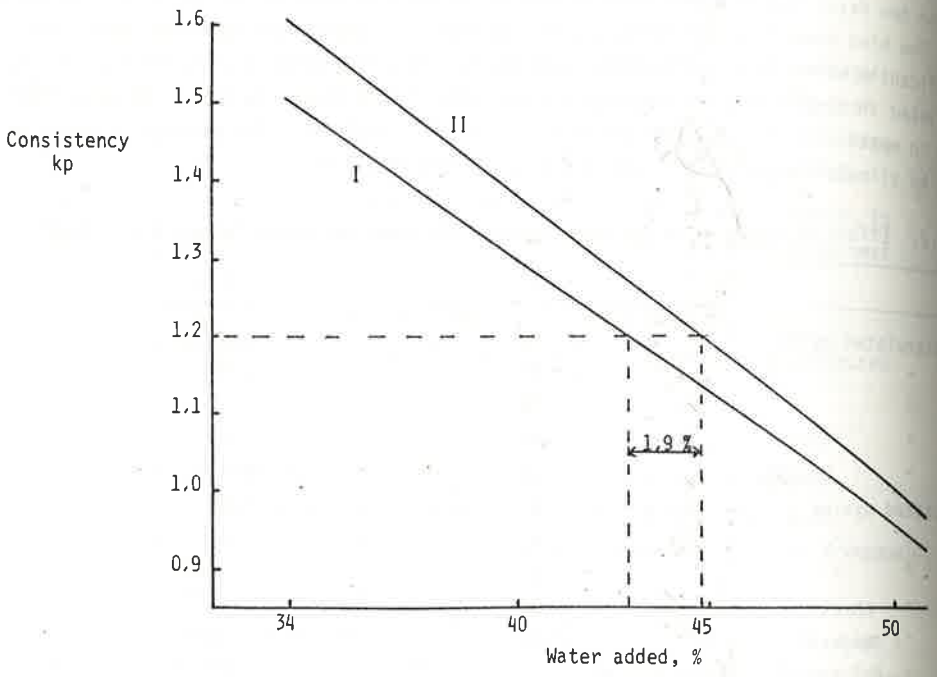

Figure 1. Effect of addition of water on the consistency of cooked sausage prepared from stimulated (I) and non-stimulated (II) beef.

The binding values calculated on this basis for stimulated and non-stimulated beef are shown in Table 4. For calculation of the value for the sausage emulsion, the results were applied by keeping constant the proportion of beef plus beef-bound water in the recipe (Tabee 4). Stimulation causes the water binding to decrease by c. 12,5 %, which means that 0,6 % of beef has to be added when preparing cooked sausage.

Table 4. Stimulated meat in the preparation of cooked sausage.

	non-stimulated		stimulated
SV value for beef + phosphate	80,0		70,0
beef content of recipe, %	10,0	18	10,6
beef-bound water, %	8,0		7,4

References

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