A comparison between pea starch and potato starch in a meat emulsion model

P.ZEUTHEN and L.H.S.BARUCH

Department of Biotechnology, Technical University of Denmark, DK-2800 Lyngby, Denmark

SUMMARY: The functional properties of pea starch and potato starch were compared in meat emulsions, which were heated to either 75, 95 or 112°C and subsequently stored, either at 5°C or at -20°C for two weeks. The emulsions consisted of lean pork, back-fat, water, curing salt and up to 4 per cent starch. The results showed that heating influenced the functional properties at all temperature levels, but at different rates, because of differences in swelling temperatures of the starch types. However, during chilled or frozen storage, the differences become much less pronounced, and it is therefore concluded that there seems to be no specific technological advantage in using pea starch in meat products.

INTRODUCTION: With the development of new procedures, it has been possible to manufacture the main components of peas: fibre, pea protein and pea starch into materials, which are well suited as ingredients in various products, such as meat products. However, systematical investigations regarding their properties when used in composite products are few. Research regarding the properties of pea fibre has been reported previously (Zeuthen and Baruch,1990). The purpose of this investigation is to report on a comparison between pea starch and potato starch in meat emulsions under various conditions.

MATERIALS and METHODS: Pea starch used in this investigation is a natural starch product. It has a neutral taste and white colour, good heat resistance, a pH near neutral and a carbohydrate content of 98 per cent. It can thus be applied in many processed food products.
The potato starch used for comparison is an unmodified, natural potato starch with a carbohydrate content of at least 97 per cent. In both cases the bacterial content is very satisfactory.
The meat emulsion to be used was produced according to a very basic recipe with very few ingredients, in order to avoid the influence of too many extraneous factors on the final results. The ingredients were lean pigmeat trimmings, back-fat, curing salt with a sodium nitrite content of 5 g per kg., water, ice and starch. After pre-cutting and equilibration of temperature overnight, mixing and comminution took place until a temperature of 14-16°C was reached, after which the mix was stuffed in artificial casings (25mm Ø). The length and weight of the sausages were measured in order to obtain sausages with uniform densities. The sausages were finally inserted in polyethylene casings, so that moisture could not be lost or gained during heating. The sausages were heated in an ordinary water bath except in the cases, where they were autoclaved. When this was done, they were inserted in cans, which subsequently were

filled with water. They were then cooked in a commercial canning plant together with 12 oz. luncheon meat cans.

The following analyses were made for the assessment: pH, measurement of cooking loss, centrifugal loss, as well as texture determinations. Determinations of protein, fat and moisture were also made. Procedures for these analyses have been described earlier (Zeuthen and Baruch, 1990, Thomsen and Zeuthen, 1988).

After production, the properties of the sausages were assessed, partly at once, partly after chilled storage at 5°C or frozen storage at -20°C, in both cases for two weeks. Finally, one batch was subjected to sensory evaluation, using a triangle test.

The experiments were made according to the following plan:

Batch No	1	2	3	4
% starch	0 2 4	0 4	0 4	0 4
Starch type	Pea starch	Pea starch	Pea starch Potato "	Pea starch Potato "
Heating°C	75	75 85 95	75 95 112	75 112
Chill 5°C	+	-	+(112)	-
Freeze -20°C	+	+	+(-at 112)	-
Sensory evaluation	-	-	-	+

RESULTS: The results of the experiments (batches no.1 - 3)are shown in Tables 2 - 4. Only pea starch is used in the first two runs. Figures with different superscripts are significantly different (5% level.) Table 2. Influence of % pea starch.

% starch	0	1.72(2)	3.45(4)
loss during heating,%	6.01^{a}	4.17^{b}	2.72^{c}
loss during storage,%			
chilled	1.49^{a}	1.10^{a}	0.63^{a}
frozen	0.41^{a}	0.66^{a}	0.72^{a}
centrifuging loss,%			
no storage	6.32^{a}	4.28^{b}	4.06^{b}
chilled	3.93^{c}	4.67^{b}	4.54^{b}
frozen	14.67^{d}	13.52^{d}	10.21^{e}
water holding capacity,%			
no storage	52.7^{a}	56.4^{b}	57.9^{c}
chilled	$53.7^{a,d}$	55.1^{e}	56.9^{f}
frozen	44.6^{g}	47.0^{h}	51.3^{i}
yield stressN			
no storage	8.52^{a}	10.25^{b}	12.91^{c}
chilled	11.37^{d}	13.37^{e}	14.30^{e}

frozen	11.32[d]	11.42[d]	12.26[d,c]
elasticity,N			
no storage	17.06[a]	21.48[b]	25.63[c]
chilled	25.80[d]	29.11[d]	28.86[d]
frozen	14.67[d]	13.52[d]	10.21[d]

Table 3. The influence of temperature on the functional properties of pea starch.

% starch	0 4	0 4	0 4
heating, C°	75	85	95
loss during heating,%	9.60[a] 3.97[b]	10.38[a] 3.56[c]	9.74[a] 2.49[d]
loss during storage,%			
frozen	negligible	negligible	negligible
centrifuging loss,%			
no storage	7.25[a] 5.34[b]	5.69[b] 5.08[b]	4.66[c] 4.55[c]
frozen	11.44[e] 11.97[e]	- 15.40[d]	13.73[d] 14.13[d]
water holding capacity,%			
no storage	47.34[a] 54.12[b]	47.40[a] 54.62[b]	49.20[a] 56.21[c]
frozen	42.59[cd] 47.53[af]	- 44.71[d]	40.75[d] 46.80[a]
yield stressN			
no storage	15.02[a] 15.59[a]	12.81[b] 14.97[a]	12.38[b] 14.35[a]
frozen	14.69[a] 19.05[bc]	17.01[c] 19.89[b]	17.78[c] 17.61[c]
elasticity,N			
no storage	31.32[a] 32.00[a]	28.10[b] 28.94[b]	25.46[b] 28.61[b]
frozen	32.00[a] 45.33[d]	37.60[c] 45.84[d]	38.62[c] 38.45[c]

Table 4. Comparison between pea and potato starch in pasteurised and autoclaved emulsions.

Legend:75, 95 and 112: heated at resp. temperatures.

starch type	control	pea starch	potato starch
heating loss%			
75	6.19[a]	3.03[b]	2.37[c]
95	8.05[b]	0.72[cd]	0.91[d]
112	14.40[c]	5.28[a]	4.84[b]
centrifuging, loss-storage,%			
75	6.13[a]	5.36[a]	8.93[a]
95	6.76[a]	5.87[a]	3.07[b]
112	2.78[b]	2.78[b]	1.94[c]
centrifuging, storage loss%			
frozen,75	9.81[a]	11.94[b]	13.62[b]
frozen,95	-	16.54[c]	16.96[c]

total water holding cap.%			
75	49.86[a]	53.57[d]	50.41[ad]
95	47.53[b]	55.25[c]	57.55[f]
112	45.02[b]	53.89[d]	54.81[e]
yield stressN			
75	15.21[a]	17.03[b]	15.40[ab]
95	12.72[b]	14.72[c]	20.41[d]
112	12.30[b]	15.53[d]	16.07[a]
yield stress, storedfrozenN			
75	17.22[b]	18.28[b]	20.00[c]
95	12.72[a]	14.72[a]	20.41[c]

The sensory evaluation showed no significant differences, using a triangle test, except in a comparison between samples without or with pea starch. Here, a difference was found at a 1 per cent level in autoclaved samples, but no preferences in acceptance.

CONCLUSION: When comparing the effect of pea starch and potato starch on the functional properties of a heated meat emulsion it will be seen that generally, the same changes take place during heating and storage. However, there are some differences of interest: The heat stability is higher in products with potato starch, if the products are heated to 75°C, because pea starch does not swell until at higher temperatures. If the emulsions are autoclaved, the heat stability should be more or less at the same level in both emulsions, so the assumption that pea starch is more suited for heating at high temperatures seems incorrect. This is supported by the observation that even short time chilled storage increases the firmness of products containing pea or potato starch to almost the same degree.
In addition, pea starch seems not to improve the sensory properties of the products.
It can therefore be concluded that although it can be shown that there are differences in the functional properties, the performance of both starches is quite similar to one another in meat emulsions. Thus, there seems to be no specific technological advantage in using pea starch.

REFERENCES:

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