WATER-BINDING PROPERTIES OF MODIFIED POTATO STARCH IN VARIOUS MEAT PRODUCTS

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Native starch derived from different botanical sources (potatoes, corn and wheat) is because of its water-binding capacity frequently used as one of the ingredients of meat products. During the last few years, some chemically modified starches have been developed which are increasingly being used in other branches of the food industry. In this connection, it was thought to be interesting to investigate whether these modified starches could also be applied in the preparation of meat products. Theoretically better results could be expected with the 'cross linked' starches than with the native ones, in particular in products processed at high temperatures (under sterilization conditions). Therefore, experiments have been carried out with three different meat products, to which three types of 'cross linked' potato starch were added, i.e. a hamproduct (2% starch added), a luncheon meat (4% starch added) and skinless Frankfurters (4% starch added). The hamproduct and the luncheon meat were processed at 80 and 110°C and the skinless Frankfurters at 105°C.

The results showed that in the three products investigated, the different starches had a stronger water-binding capacity than polyphosphates. No significant differences concerning water-binding capacity could be observed between the products prepared with 'cross linked' potato starch and those prepared with native potato starch, not even in the products processed under sterilization conditions.

LE POUVOIR HYDRATANT DE L'AMIDON MODIFIÉ EN PLUSIEURS PRODUITS DE VIANDE

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L'amidon originaire de différentes sources végétales (pommes de terre, maïs et froment) a été appliqué fréquemment à des produits de viande pour sa capacité de lier l'eau. Pendant les dix dernières années l'industrie de l'amidon a développé un nombre d'amidons en les modifiant chimiquement. Ces amidons modifiés ont été appliqué de plus en plus aux autres branches de l'industrie de produits alimentaires. C'est pourquoi il est intéressant si les amidons modifiés peuvent aussi servir pour les produits de viande. En principe on s'attendrait à ce que le pouvoir hydratant des amidons 'réticulés' serait meilleur que celui de l'amidon natif, surtout quand il s'agit de produits traités aux températures élevées. On a fait une investigation par rapport à trois produits de viande différents, à savoir un produit du type jambon cuit (2% d'amidon additionné), de 'luncheon meat' (4% d'amidon additionné) et de saucisse de Francfort sans peau (4% d'amidon additionné).

Trois sortes d'amidons 'réticulés' originaires de pommes de terre étaient ajoutées aux produits nommés. Les résultats de l'investigation montraient que les amidons différents avaient un pouvoir hydratant plus grand que les polyphosphates dans les produits nommés. Quand au pouvoir hydratant il n'y avait pas de différence distincte entre les amidons 'réticulés' et l'amidon natif, originaire de pommes de terre, même pas dans les produits traités aux températures élevées.

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DIE WASSERBINDENDEN EIGENSCHAFTEN VON MODIFIZIERTEN KARTOFFELSTÄRKEN IN EINIGEN FLEISCHPRODUKTEN

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Stärkemehle verschiedener pflanzlicher Herkunft, wie Kartoffel-, Mais-und Weizenstärke, werden wegen ihrer wasserbindenden Eigenschaften öfters in Fleischprodukten angewandt. In der letzten Jahren wurden modifizierte Stärkemehle entwickelt die für Gebrauch in anderen Lebensmitteln mehr und mehr Eingang gefunden haben. Es war deshalb interessant zu untersuchen ob die modifizierten Stärkemehle auch in Fleischprodukten angewandt werden können. In Bezug auf ihre wasserbindenden Eigenschaften wären bessere Ergebnisse zu erwarten von vernetzten Stärkemehlen als von nativen Stärkemehlen vor allem in Produkten die hoch erhitzt werden (Sterilisation). Die Untersuchung wurde ausgeführt mit drei Fleischprodukten: ein Schinken-Produkt (mit 2% Stärke), ein 'Luncheon Meat' (mit 4% Stärke) und Würstchen mit Schäldarm (mit 4% Stärke).

Drei typen von vernetzten Stärkemehlen wurden angewandt. Das Schinken-Produkt wurde bei 80°C erhitzt, Luncheon Meat bei 110 und die Würstchen bei 105°C. Die Ergebnisse zeigten, dass die Stärkemehle die Wasserbindung mehr erhöhten als Polyphosphate. Hinsichtlich der Wasserbindung gab es keine signifikanten Unterschiede zwischen vernetzten Stärkemehlen und nativem Stärkemehl auch nicht im sterilisierten Produkte.

ХАРАКТЕРИСТИКИ ПО ВОДОСВЯЗЫВАЮЩЕЙ СПОСОБНОСТИ ИЗМЕНЕННОГО КАРТОФЕЛЬНОГО КРАХМАЛА В РАЗЛИЧНЫХ МЯСОПРОДУКТАХ.

ЦЕНТРАЛЬНЫЙ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ г. Зайст, Голландия.

Дауэ Трернит

Натуральный крахмал различного растительного происхождения (из картофеля, кукурузы и пшеницы), ввиду его водосвязывающих способностей, употребляют как составную часть в мясных продуктах. В течении последних лет были разработаны некоторые химически измененные крахмалы, внедряемые все шире в других отраслях пищевой промышленности. В этой связи казалось интересным изучить, смогут ли эти измененные крахмалы так же быть применены и при изготовлении мясных продуктов.
Теоретически, следовало бы ожидать лучших результатов с "сшитыми" крахмалами, чем с натуральными, особенно в продуктах, обработанными при высоких температурах (при условиях стерилизации). Поэтому были проведены эксперименты с тремя различными видами мясных продуктов, с добавлением " сшитого" крахмала, а именно: окорочное изделие (с добавлением 2% крахмала), изделие из рубленой свинины (с 4% крахмала) и изделие сарделечного типа без оболочки (с 4% крахмала). Окорочное изделие и рубленая свинина подвергались воздействию температуры 80 и 110°C, а сарделечное изделие температуры 105°C.

Результаты показали, что во всех трех случаях крахмалы имели водосвязывающую способность высшую, чем полифосфаты. Не удалось обнаружить существенных различий по водосвязывающей способности между продуктами, изготовленными с применением "сшитого" крахмала и продуктами, изготовленными с натуральным картофельным крахмалом, даже обработанным при условиях стерилизации.

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WATER BINDING PROPERTIES OF MODIFIED POTATO STARCH IN VARIOUS MEAT PRODUCTS

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INTRODUCTION

In various countries native starch derived from different botanical sources (potato, corn and wheat) is being used since a long time in different meat products. The water binding capacity of starch has been one of the main reasons for its use in meat products. During the last few years some chemically modified starches have been developped which are increasingly being used in the food industry. In consequence it was thought to be interesting to investigate whether these modified starches could be applied also in meat products.

The most important area of food starch modification includes the esterified and etherified starches. Two main groups of derivatives can be distinguished, namely monostarch derivatives and distarch derivatives of which the latter ones are the most promising for application in meat products. Distarch derivatives or cross-linked starches can be made with a bifunctional reagent reacting with hydroxyl groups on two neighbouring starch molecules, forming a cross-link or a bridge. By the formation of cross-linking groups the granule 'strength' will be increased. Increasing the granule 'strength' will cause an altering of the paste characteristics of the starch. The effect of importance to the food manufacturer is that a cross-bonded starch will give a paste which is more stabile at high temperatures, acid conditions and high rates of shear (1). Particularly, the first property could be of importance to meat products processed under sterilization conditions.

Reagents that are being used for ester cross-linkage are phosphorus oxychloride, sodiumtrimetaphosphate (for producing distarch phosphates) and adipic acid (for producing distarch adipates). For ether cross-linkage is being used epichlorohydrin (for producing a distarch glycerol). One of the disadvantageous features of the use of cross-linking is that the gel strength will be reduced. This disadvantage can be avoided by using a combination of cross-linking with the formation of monostarch esters or monostarch ethers. Reagents used for producing monostarch esters are acetic anhydride (monostarch acetates) and sodiumtripolyphosphates (monostarch phosphates). Monostarch ethers can be formed with ethylene oxide (hydroxyethylstarch) and with propylene oxide (hydroxypropyl-starch).

On the basis of the biological and toxicological findings obtained by different research institutes all major modified food starches are regarded to be safe and to pose no hazards to health and are FAO/WHO approved. It is outside the scope of this investigation to go more into details of the toxicological problems related to modified food starches. For further information of these aspects will be referred to publications of FAO/WHO (2).

The first objective of this work was to investigate whether cross-linked potato starches had a better water binding capacity than the corresponding native starch when applied in meat products. The second objective was to compare the influence of starch (native or cross-linked) with the influence of polyphosphates on water binding in meat products. As a reference served a control-batch without both starch and polyphosphates.

EXPERIMENTAL

Different modified potato starches have been tested in two comminuted products (luncheonmeat and skinless Frankfurters) and in a ham-type product. For all three products the experiments have been carried out according to the same plan, as described in table 1.

Luncheonmeat

Composition

A luncheonmeat was made out of the ingredients as described in table 2. On top of these ingredients the different starches (or polyphosphate) were added according to the level mentioned in table 1.

Method of preparation

A luncheonmeat batter was prepared on the basis of a very finely comminuted mixture of the beef, water, NaCl and other additives (final temp./mixture 8°C). To this mixture the different starches (or polyphosphate), the pork trimmings and the pork fat were added. This meat batter was comminuted to a rather high degree of fineness (final temp./meat batter 14°C). The comminution was carried out with a normal type meat-chopper with a bowl-speed of 50 rev/min and a knive-speed of 3000 rev/min. The luncheonmeat batter was stuffed into cans of 200 g (76 x 58 mm) and these units were processed resp. at 80°C and 110°C.

Determination of water binding capacity

As a measure for the water binding capacity of the different starches (or polyphosphate) in luncheonmeat the formation of jelly of 5 cans of each batch was determined.

Skinless Frankfurters

Composition
The Frankfurters were composed of the ingredients mentioned in table 3. On top of these ingredients the different starches (or polyphosphate) were added according to the level mentioned in table 1.

Method of preparation
A meat batter was prepared on the basis of a very finely comminuted mixture of beef, water, additives and half of the NaCl (final temp./mixture 8°C). To this mixture the different starches (or polyphosphate), the rind/water emulsion, the pork fat and the other half of the NaCl. The meat batter was comminuted to a rather high degree of fineness (final temp./meat batter 15°C). The comminution was carried out with a normal type meat-chopper with a bowl-speed of 50 rev/min and a knive-speed of 3000 rev/min. Subsequently the meat batter was stuffed into artificial casings (diameter 18 mm) and the Frankfurters were smoked during 20 min at a temperature of 45°C and a relative humidity of 80%. After peeling the Frankfurters were put into glass jars (7 Frankfurters per jar, appr. 200 g) together with an equal amount of water. These units were processed at 105°C.

Determination of water binding capacity
As a measure for the water binding capacity of the different starches (or polyphosphate) in Frankfurters the increase resp. decrease in weight of the Frankfurters during the heating proces was determined. Therefore the average weight of Frankfurters of 5 jars of each batch was determined resp. 1 hour before and 18 hours after processing. Also as a measure for the water binding capacity a part of the meat batter was stuffed into cans of 200 g and processed at 105°C. After that the formation of jelly was determined of 3 cans of each batch.

Ham-type product

Composition and method of preparation
Into pieces of ham meat, reduced to a size of appr. 300 g a brine was injected with a single needle to an amount of 20% of the raw material. The composition of the brines in which also the different starches (or polyphosphate) were dispersed (resp. dissolved) is mentioned in table 4. The injected pieces of meat were tumbled, cut into smaller pieces (appr. 50 g) and tumbled once more. The product was processed in cans of 450 g at resp. 80°C and 110°C.

Determination of water binding capacity
As a measure for the water binding capacity of the different starches (or polyphosphate) in the ham-type product the formation of jelly was determined of 5 cans of each batch.

RESULTS AND DISCUSSION

The results of the water binding capacity of the batches of the different products are put together in table 5. Comparing the results of the measure for water binding in the different products for batches with native and cross-linked starches on one hand with the results for batches with polyphosphate and for control batches on the other hand there is a statistically significant difference ($P<0.01$) in case of the products luncheonmeat en skinless Frankfurters.

The batches with polyphosphate of the ham-type product processed at 80°C and 110°C are showing a less pronounced difference in water binding compared with the batches with the different starches. Nevertheless all applicated starches turned out to be good water binders.

With regard to the main objective of this investigation, namely a comparison of native potato starch with different cross-linked potato starches concerning water binding capacity in meat products processed at different temperatures, the results are showing clearly that there is no difference of any importance between batches with native starch and batches with the different cross-linked starches in both luncheonmeat and skinless Frankfurters.

In the ham-type product of both processing temperatures native starch seems to have a more positive influence on water binding than cross-linked starches. However in practise these differences are still to be considered of minor importance.

All these results are in conflict with the before mentioned theory that cross-linked starches will be more stable to the application of high temperatures. A possible explanation could be that the supposed higher stability at high temperatures applies only to rheological properties, such as conservation of viscosity, and not or less to water binding properties. In this case the application of cross-linked starches will only be profitable in more fluid food products. Another possibility is that the level of applied temperatures which was rather high for meat processing purposes was not high enough to produce significant differences in water binding between native and cross-linked starches.

As a conclusion it can be said that for improving water binding of the meat products in question there is no reason for the use of cross-linked potato starches instead of native potato starch.

REFERENCES

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(2) WHO/FAO. Toxicological evaluation of some food additives including anticaking agents etc. WHO Food Additives Series no. 5 (1974) 329-378

Table 1 - Plan of experiments

Batch/Added substance	Description of starches	Luncheonmeat Level added substance (%)	Luncheonmeat Proc. temp. (°C)	Frankfurters Level added substance (%)	Frankfurters Proc. temp. (°C)	Ham-type product Level added substance (%)	Ham-type product Proc. temp. (°C)
Perfectamyl D8	native potato starch	4	80/110	4	105	2	80/110
Perfectamyl P10X	distarch phosphate (potato)	4	80/110	4	105	2	80/110
Perfectamyl AC75	acetylated distarchphosphate (potato)	4	80/110	4	105	2	80/110
Perfectamyl A25	hydroxypropyldistarch glycerol (potato)	4	80/110	4	105	2	80/110
Polyphosphate	-	0.3	80/110	0.35	105	0.4	80/110
Control	-	-	80/110	-	105	-	80/110

Table 2 - Composition of luncheonmeat

Ingredients	(%)
boneless beef	28.0
offals	12.5
water	15.5
NaCl	2.0
additives	o.4
lean pork trimmings	10.4
pork back fat	31.2

Table 3 - Composition of skinless Frankfurters

Ingredients	(%)
boneless beef	26.0
water	27.0
NaCl	4.7
additives	0.7
rind/water emulsion:	
cooked rind	3.4
water	7.0
pork back fat	31.2

Table 4 - Composition of brine

Ingredients	Brine with starch (%)	Brine with polyphosphate (%)	Brine without starch or polyphosphate (control batch) (%)
water	80	88	90
salt	10	10	10
starch	10	-	-
polyphosphate	-	2	-

Table 5 - Results of water binding capacity

Batch/added substance	Luncheon meat Amount of jelly (%)		Skinless Frankfurter Increase(+)/Decrease(-) in weight (%)	Skinless Frankfurter Amount of jelly (%)	Ham-type product Amount of jelly (%)	
	80°C	110°C	105°C	105°C	80°C	110°C
Perfectamyl D8	0	0	+10.6	0.5	0.8	10.6
Perfectamyl P10X	0	0	+ 9.9	0.2	2.0	16.8
Perfectamyl AC75	0	0	+10.2	0	1.5	14.0
Perfectamyl A25	0	0	+ 9.7	0	2.2	14.3
Polyphosphate	3.2	7.1	- 2.3	18.4	0.5	17.7
Control	5.9	14.0	- 6.4	20.8	7.0	30.1