일차배양 쥐간세포로부터 간트리글리세리드 lipase의 유리

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요약

쥐간세포 배양시 간트리글리세리드 lipase의 유리 및 호르몬 조절에 관하여 연구하였다. 배양 2일째 혈관을 첨가구 배양액에 유리된 lipase 활성은 24시간 동안 계속 증가하였다. 반면에 혈관을 첨가구의 lipase 활성은 혈관을 첨가구에 비하여 10%에 지나지 않았다. 간세포를 anti-hepatic triglyceride lipase IgG와 배양시 lipase 활성이 92%까지 저해되었다. Monensin 첨가시 lipase 활성이 저해는 61%였다. 인슐린은 lipase 활성을 20% 상승시켰으나 dexamethasone는 44% 저해시켰다. 이상의 결과로 미루어 보아 간트리글리세리드 lipase는 혈관 첨가하여 분비 및 유리되며 그 분비는 호르몬에 의해 조절됨을 시사한다.
Safety and Function of Phosphates in Food Processing

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Ladies & gentlemen

It is a great pleasure for me to be invited to speak at the 20th anniversary of the Korean Society of Food & Nutrition. I am happy to inform you of the functions and uses of phosphate as food additives and also functional additives in food processing. Let us start first with a general remark that a number of orthophosphates, particularly calcium phosphate, magnesium phosphate, and iron phosphate are used as mineral enrichment in dietetic or health food, and that another category, the polyphosphates, are widely used as functional ingredients and food additives in the processing of the food applications. Let us now look into the functions of phosphate blends in the various applications.

The Use Phosphate as Emulsifiers in Processed Cheese

One of the first applications of phosphate as processing aid was started about 60 years ago as emulsifiers in processed cheese. Our company BK Ladenburg holds the patent for the first time on the use of phosphate in this area. Generally speaking it is known that processed cheese and related products are cheese preserved, which means that raw cheese has been converted into a product of reasonable longer shelflife. Cheese is made from coagulated milk occurred in a fermentation process during a maturing process. Cheese is a natural product and while the microbiology reaction during the maturing process is not interrupted and maturing is going on the cheese or its by products becomes spoiled eventually. To improve shelflife processed cheese was invented. There are two ways of stopping or at least retarding the spoiling process:

1. Pasteurization, and
2. Sterilization.

Therefore cheese has to be heated up during a certain processing time under constant stirring and due to this it would separate into its basic constituents, water, fat, and a conglomeration of casein and will therefore completely lose its particular fine structure. This has to be seen as an effect caused by the chemical composition of Cheese material.

The casein complex undergoes many changes as soon as rennet or acid is added and the calcium is bound to the caseinate and precipitates finally as calcium caseinate. The emulsion which contains inclusions of fat particles and to which the water is added in the form of hydration water is bound are the starting material from which prior to cheese is made from.

This system is collapsing during a heating process, fat and water are separating. This is exactly what processed cheese wants to prevent, because processed cheese is supposed to have a fine structure of an emulsion as similar as possible to the structure of natural cheese, due to the fact that a processed cheese is a fat in water emulsion the fat particle need to be accurately dispersed in a caseinate solution. To prevent the collapse of that structure the calcium caseinate needs to be converted into sodium caseinate and through this is able to react as a protein coating for the fine fat particles, dispersing them evenly in the whole liquid.
medium, sodium caseinate can also bind the water contained in the cheese mass and to prevent the separation of liquid. For this purposes emulsifying salts with good sequestering properties for calcium are requested, these sequestering agents are usually polymeric phosphate and they act as ion exchanger to substitute the calcium of the original calcium caseinate by forming a sodium caseinate, they are ideal for this purpose because they form insoluble salts with the calcium molecules and therefore prevent crystalization.

These emulsifying salts are particularly designed blends of Bk ladenburg and are marketed under the brand name of JOHA. They are used in a variety of processed cheese and the phosphate blends with particularly high sequestering properties are used mostly for spreadable processed cheese, low fat processed cheese, for pasteurized processed cheese, cheese dips and for quick melting block cheese.

**PHOSPHATES USED FOR MEAT PROCESSING**

Polyphosphates are of great importance in a large variety of meat processes. The raw meat material as beef, pork and poultry containing about 70% of water bound to the muscle protein particularly actin and myosin. They linked to each other in a loose network of filament to which the water molecules are bound by electrostatic force. These network structure is maintained by presence of adenosin triphosphate a substance produced in the metabolic process in animals, it is decomposed post mortem within about 20H⁺ after the slaughtering and is not reproduceable by nature. That is the reason that the function of this network structure of muscle protein is not so strong anymore and looses its water absorptive capacity which is absolutely essential for the processing of meat product. The major function of particularly alkali polyphosphates is to reanimate or also to take over the function of adenosin triphosphate that means the use of particularly polyphosphates reinstate the water absorptive capacity of meat after the slaughtering process. The polyphosphates are mainly used in the following product ranges

- Comminuted for any kind of minced meat including meat emulsion, cooked cured meat like ham, poultry products like turkey rolls, chicken rolls, any kind of battered and precooked products made of poultry meat, molm etc, seafood like shrimps, fish fillet abalone.
- Besides the functionality of polyphosphate it is necessary to select out of the available products with additional properties.
  - Optimal reaction with muscle protein
  - Optimal water absorptive capacity
  - Quick dissolving properties without forming lumps in any kind of solution.
  - Adjustment in pH value because of taste
  - Compatibility with other additives like organic acid

Due to our experience one single phosphate out of the available selection is not able to fulfill all the properties mentioned before hand. Therefore it is necessary to blend various polyphosphates and that is what we do. Our products also undergo special treatment in our case to instantiate this product to give them the best possible solubility.

**MEAT EMULSIONS**

The meat emulsions consist of very fine particles wrapped in a cover of a muscle protein gel. This protein coagulates during the cooking or smoking process and results at the particular desired texture and bite of a hotdog or frankfurter sausage or any other fine emulsified meat product.
PHOSPHATES IN THE USE OF CURED PRODUCTS LIKE HAM

There is also a big demand for the use of polyphosphate in cooked cured meats, more popular expression of such products are in Asia mainly any kind of hams, it is absolutely essential from a quality point of view as well as from an economic point of view here to bind first of all the natural juice in the meat and also the brine solution which is injected or tumbled into the meat product and it is also absolutely essential that this brine remains in the meat and the cooking loss is limited as much as possible.

To prevent bacteria growth in the meat product it is required to work under low temperature conditions while pumping, curing until the start of the heating process. In modern factories brine solution are kept between 0 celsius and 4 celsius. These rigid conditions make it very often difficult to dissolve the combination of phosphates properly. Undissolved phosphate particles and lumps cannot bind the water of the meat product because of non-availability in the meat and besides that can cause damage and inconvenience in clogging the injection needles. Therefore highly soluble phosphates, for example curafos 700 instant should be used to avoid those problems.

As a guideline it is understood that the phosphate content in the finished product should be approximately 0.5% because this figure represents the best possible water binding capacity. Extended injection rates above 35 – 40% requires additional binding properties which can be achieved by the use of hydrocolloids or vegetable proteins or milk proteins. This highly injected products need also additional flavouring and addition of selected food colours.

OTHER APPLICATIONS OF PHOSPHATE IN MEAT PROCESSING

Products made of poultry like turkey, chicken and others tend to be dry after cooking or frying, so it became very common to soak those chicken pieces in a phosphate solution to prevent a too high cooking loss and produce a more juicy and tasty product, it becomes more and more common also to treat breaded poultry products prior to the breading process while soaking it for a short period into a high concentrated phosphate brine, it prevents the separation of water during the deep cooking period and also therefore the breading or batter will stick better to the meat piece in the frying process.

The use of phosphate in precooked products for microwaving afterwards is getting more and more common and is widely experimented.

Not only the meat pieces but also sausages and gravies, particularly gravies containing cheese or caseinate remain in a more attractive condition when using some phosphates to prevent drying out of the product during the microwaving process.

APPLICATION OF PHOSPHATES IN SEAFOOD

A quite popular use of phosphates is the seafood production

TREATMENT OF SHRIMPS

The majority of shrimps which are caught and processed in Asia is still the frozen block of either peeled, headless shell on, or head on shell on. From the time of catching until and during processing the shrimps are losing a considerable amount of their body fluid and a big amount also of minerals and vitamins, the same effect also applies on frozen fish fillet.

Trials conducted in Germany with fish fillet prior to freezing treated with two designed phosphate blends of BK ladenburg and you can definitely see that after thawing this fish fillets remain
in a significantly better quality than untreated ones.

Besides a substantial prevention in drip loss also
the loss in protein as well as in vitamin B1 was
significantly lower than untreated fish fillets.

The economics of treatment of headless shrimps
show the same positive result particularly the cook-
ing loss later on was much lower than a non treated
shrimp. This indicated a much juicer and tastier
product besides the economic question of having
less drip loss or even sometimes some gain
in weight.

The processing was done in a shrimp processing
plant in the gulf of texas under supervision of the
A & M texas university. Besides weight gain, res-
pectively prevention of drip loss. The procedure
of mechanically peeling of shrimps could prove
in trials in that, by adding a small amount of a
phosphate blend solution improves significantly
the peelability of raw shrimps. Most of those shrim-
mps are afterwards IQF frozen, and here also the
phosphate solution acts as a cryo protectant to pre-
vent freezer burn.

PHOSPHATE BLEND IN SURIMI!

In cooperation with a surimi producer in the
united state, trials were conducted to prove the
significant better gel strength of surimi when using
a designed phosphate blend instead of ordinary
sodium tripolyphosphate.

The combination of the surimi base plus 0.3%
fibrisol 414C has proven to be more outstanding
product than defined phosphate blend up to now
which was also confirmed in Japan as well.

OTHER APPLICATIONS FOR
PHOSPHATE BLENDS

Phosphates are quite suitable to be blended with
organic acids. Those blends are particularly desig-
ned to extend shelf life and freshness of fillets
or other seafood products which get spoiled easily
especially during transportation if the refrigeration
is not sufficiently cold. The antioxidant comparison
shows this effect measured in the increase of TBA
(Thiobarbituric acid test) in milligrams per thou-
sand grams treated product.

The last application I want to refer to, is to use
polyphosphates, to prevent the formation of stru-
vite, which is chemically a magnesium ammonium
orthophosphate. Struvite appears as small glassy
crystals. Their appearance are regarded by the
consumer as an inferior product.

Magnesium is a trace element in many species
of fish, particularly in tuna. The high-polymer pho-
sphate are complexing the magnesium so it will
no longer be available for the crystal formation.
The tuna or other fish chunks or steaks should
be shortly dipped in a 3–4% phosphate solution
in addition to a high concentrated common salt
brine.

Last but not least phosphates are since a long
time known and used in the production of bread,
pastos, pizzas, etc. Generally, partly neutralized
phosphates are used in combination with sodium
bicarbonate as a leavening system and where the
carbon dioxide from the bicarbonate then react
with the dough.

In principle this reaction is not very complicated,
in practice however the number of process-related
parameters make the design of such baking powder
very complex. I can say that the release of the
carbon dioxide can be controlled by the dissolving
properties of the selected phosphate.

An acid sodiumpyrophosphate, for example, one
of the most common leavening agent can have dif-
frent rates of dissolution, depending on the crys-
tallizing structure that it had been given. A lower
rate of reaction is required for the production of
light and viscous types of dough, sponge cakes,
and ready to use mixed flour.

An acid sodium aluminiumphosphate for exam-
people has a slow rate reaction and is particularly suitable for refrigerated raw doughs as those used in pizzas.

Particularly designed phosphates are also used in gelating reactions and antioxidants in juices and pickles and are widely used as mineral enrichment in the form of magnesium and iron phosphates in health food and baby formulas and chocolate drinks.

PHYSIOLOGICAL ASPECTS OF PHOSPHATE ADDITIVES

First of all if we discuss about the physiological importance of phosphate and phosphate related additives it is necessary to mention that phosphates are naturally a part of almost all food stuffs and are mostly chemically related to other substances.

The highest content of phosphates are mainly in meat, fish, poultry, cereal and in vegetable protein.

Phosphate is one of the important parts in the human body, respectively its metabolism.

Approximately 4% of the body weight of an adult person is phosphate. This phosphate is permanently exchanged. Therefore release phosphate has to be replenished continuously through foodstuff.

Approximately 92 up to 95 percent of phosphate contained in foodstuff comes from natural sources. The rest is represented by phosphate containing additives, lecithin and some flavouring agent

The human body uses natural as well as added phosphate in the same way. All phosphate types are absorbed into intestinal parts and released into the metabolism.

To determine now the physiological behaviour it is necessary to determine the total phosphate intake.

The FAO-WHO is using for all additives the acceptable daily intake (ADI) to show maximum level for the consumption of additives.

CHART OF ACCEPTABLE DAILY INTAKE

Value 30\(\text{mg}\)/kg corresponds to 2\(100\text{mg}\)/person

The acceptable Daily intake for phosphates and phosphorus containing ingredients in the summarized phosphorus-content from
* natural phosphorus-containing ingredients of foodstuffs
* added phosphorus-containing additives e. g. phosphates

Fig. 1. ADI for phosphates and other phosphorus-containing ingredients of foods in expressed as phosphorus.

For phosphate additives consequently there is no specific acceptable daily intake of the additive but the value for the total phosphate intake combined of added and natural phosphate expressed as phosphorus.

Definition by Expert Committee of FAO/WHO

Definition
The ADI is the amount of a toxicologically tested compound, expressed as mg/kg body weight, which can be consumed by a man each day for total lifetime without any risk for health

Prinzip 1% = ADI of no effect dose of toxicological evaluation

Fig. 2. Acceptable Daily Intake ADI.

The daily quantities can be determined statistically and you can see they are significantly lower than the acceptable daily intake of approximately 2\(100\text{mg}\) p. per person per day. The added phosphorous represented by additives is in the average only 100 mg per person per day. Presumably the phosphate intake out of additives are absolutely non significant and have absolutely no influence on the human body in terms of health or toxicological parameter.
Allowing me to convey again my best wishes to all organisers and guests of the Korean Society of Food and Nutrition to achieve during this meeting the success and information you all are looking for. Thank you!