



biochem s.r.l. Biochemical Research Center

Meat starter cultures

Meatferm



Meat starter cultures

Starter cultures for direct meat inoculation (DMI[®])

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Section 1

Understanding bacteria :

Making fermented sausages is a combination of the art of the sausage maker and the performance of bacteria.

In fact, through its experience and knowledge, the sausage maker monitors temperature and humidity which allows to control the reactions that take place inside the sausage.

Unfortunately during the period of fermentation that take place in the maturation rooms are developed together good and dangerous bacteria and most of the time the dangerous one that are more resistant at bad growing conditions, takes the force to predominate the fermentation with the final consequence to have bad products that contain dangerous bacteria.

1.1 The role of temperature on bacteria growth

All bacteria need moisture, nutrients and warm temperature to grow, most bacteria need oxygen (aerobic) others thrive without it (anaerobic).

Growing temperature of bacteria goes from 25 °C to 50 °C, some of them, especially the dangerous types, are able to survive to high temperatures because they form spores.

For the meat sector, temperature of meat fermentation and of meat bacteria starter goes from 24 to 38 °C. Temperature of 24 °C make long fermentation time but mainly produce more aromatic final product increasing quality. At the opposite temperature near 38 °C make short fermentation time and process but has influence on final product quality.

Section 2

Lactic acid bacteria

2.1 Starter cultures in meat fermented products

The lactic acid bacteria are the engine that powers making fermented foods.

All lactic acid bacteria are micro-aerophilic that is they require very small amount of oxygen to function and to activate their internal metabolism.

The lactic acid bacteria in meat play an important role related to acidity increasing (lowering the pH), that has two direct effects: inhibit the development of dangerous bacteria that are inhibited at low pH than 5 and at the same time they alter the link with the water, encourages the drying process on meat fermented products.

2.2 Types of bacteria that permit fermentation process

The species of lactic acid bacteria with the best acidifying activity producing mainly lactic acid during their fermentation are most the *Lactobacillus* species, some *Pediococcus* species can be used also.

This table shows the main species of *Lactobacillus* and *Pediococcus* used in the meat industry with their optimal temperature of growing and salt tolerance.

Species	Optimal growing temperature °C	Growing salt limit
<i>Lactobacillus sakei</i>	30	9
<i>Lactobacillus farciminis</i>	37	10
<i>Lactobacillus plantarum</i>	30	13
<i>Lactobacillus rhamnosus</i>	37	8
<i>Lactobacillus curvatus</i>	24	10
<i>Lactobacillus pentosus</i>	35	9
<i>Pediococcus Acidilactici</i>	40	10
<i>Pediococcus pentosaceus</i>	35	7

This bacteria are directly responsible of fermentation process and they accomplish this by consuming sugar and producing lactic acid.

This makes sausages safe, but in part a tangy-sourly flavour to the product which becomes more pronounced when more sugar is added.



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Section 3

Colour and flavour forming bacteria

3.1 Staphylococcus and Micrococcus responsible of flavour and colour

The colour and flavour forming bacteria species in meat product are mainly represented from the family *Staphylococcus*. Some times in some fermented meat products the *Micrococcus* bacteria was been founded but the recent microbiology research has find in the staphylococcus specie the right response to flavour and colour forming in the meat production process.

3.2 Temperature of growth and salt tolearance using Staphylococcus and Micrococcus

Their main mechanism of working is the transformation of Nitrate in nitrit, during ripening they react with oxygen creating new nitrate source restarting their methabolisms. Dry fermented sausage containing an insufficient number of these bacteria will not cure properly , and ultimately the colour and the flavour of meat will suffer.

The growth of Staphylococcus and Micrococcus species is very slowly and are best used in low fermented sausage which are made with Nitrate or nitrite/nitrate. Also they can be used in combination with lactic acid bacteria for fast fermented sausage.

In this table are show the optimal temperature of growing and their salt tolerance limit

Species	Optimal growing temperature °C	Growing salt limit
<i>Staphylococcus carnosus</i>	30	16
<i>Staphylococcus xylosus</i>	30	15
<i>Micrococcaceae spp.</i>	30	16

Staphylococcus spp. are preferred to Micorococcus spp. because they are anaerobic bacteria at opposite to Micrococcus and they can grow deep on the meat products without oxygen.

Staphylococcus bacteria can grow in upper than 5 % concentration of salt and in addition to their nitrates and nitrites reducing capacity they are mainly focused to contribute to flavour development by :

- Proteolysis- break down of protein into free aminoacids
- Lypolysis- break down of fats into free fatty acids



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Section 4

Meat fermentation

4.1 Favorable characteristics for fermentation process

Meat fermentation is characterized by lactic acid bacteria, either naturally present in meat products or added like starter culture.

Fermentation is required not only to produce a highly desirable product, but also to prevent the growth of spoilage and pathogenic bacteria.

When a sausage is introduced into a fermentation chamber, the bacteria hold all cards in their favor:

- Warm temperature
- Moisture
- Sugars normally content in meat or added in the mix
- Oxygen

When a sausage is stuffed the only inhibiting agents are the salt and nitrite which were introduced during curing or mixing. The selected meat always contains some bacteria that are not wanted from the sausage maker and they will grow in time. Initially there is a strong competition in meat from the different bacteria but the right bacteria added in high concentration through direct meat starter culture will win the natural competition.

4.2 Fermentation product : lactic acid responsible of the acidity and lowering pH

The main product of the right bacteria fermentation is the lactic acid that is responsible of the acidity growing and the lowering of pH.

Speed of fermentation is due to the sugar content and more directly to the temperature that has not to be higher than 38 °C.



Fermentation stop is regulated from different factors and in particular to the absence of sugar and to the lower temperature.

Also Free water activity has influence on fermentation, in fact an $A_w < 0.95$ is responsible to the stopping of bacteria due to the fact that water is the essential element of bacteria survival.



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Section 5

The main types of fermentation

5.1 Traditional slow fermentation and fast fermenting process

Fermentation process can be divide in two section based on the technology applied and on the final product requested : Traditional Slow Fermentation and Fast Fermenting Process.

Traditional Slow Fermentation

Traditional slow fermenting process is due to the natural meat fermentation using meat selected bacteria that have mainly the effect to protect the product against contamination.

Step of traditional slow fermentation of meat products are mainly : curing (when ground meat , salt, nitrite, and protective lactic acid bacteria are mixed all together and left at 5 °C), fermentation (this process takes place in fermentation chamber from temperature of + 20 to + 30 °C and are need 5 – 8 days for reach the right pH), ripening or smoking (this are the two last process before sell the products and depend on the final product characteristics that are required).

Fast Fermenting Process :

Fast fermenting process with the use of lactic Acid bacteria mainly staphilococcus and lactobacillus series was introduced in last century and the base of this technology of production is to create meat product that are stable and where fermentation process and colour forming is directed by the bacteria added trough powder with high right bacteria concentration.

During fast fermentation process the Curing process is not need, the first step is the mixing where meat, starter culture , and dextrose are mixed and immediately put on fermentation process. Fermentation process takles place in fermentation room at temperature normally from 30 to 35 °C .

The rapidity of the pH dropping is mainly regulated from the amaount of lactic acid bacteria added and from the amount of sugar added during mixing.

Normally a quantity from 0.1 to 1.5 % of glucose is added in the mixing with the lactic acid bacteria, this amount is responsible of the final product pH dropping and of the speed of fermentation. Most of time is not recomende to add more than 0.5 % of glucose this because a fast fermentation hinibit the development staphylococcus specie and so reduce the forming of the right colour and aroma.



Fast fermentation process take normally from 12 to 15 hour at opposite of the traditional process that take 5 -8 days, also the fast pH dropping due to the adding of lactic acid bacteria and glucose reduce the water loss with the final consequence of high final yield. The final pH that have to be reached during fermentation process goes from 5.30 to 4.80 , normally at pH 5.30 meat is introduced in cooling room stopping slowly the fermentation in the way to reach a final product ph of 5.0 . Fermentation process is followed like in the traditional technology by the ripening or by the smoking process. Time and smoking process procedure is depending on final product characteristic required.



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Section 6

Advantages to use Meatferm starter culture

6.1 Why to use Meatferm starter cultures

Meatferm starter culture for the meat industry are conceived for the production both of tradition that for fast fermenting meat process. The right selection of the bacteria is depending on the final product need but generally the advantage of the meatferm starter culture can be resumed in the following point:

- The high number of the right bacteria give reliable and stable production of the fermented meat, reducing the possibility of the development of unwanted microflora.
- Meatferm starter culture are created to direct meat inoculation **DMI®**, so they are really simply to use. Every pocket report in Unit the quantity of meat to be inoculated 1 U = 100 kg of meat.
- The range of product give the possibility to select the right bacteria and the right mixture depending on the final product need.
- The single strain bacteria give the possibility to the sausage producer to make his mix depending on meat quality and on final product characteristics request.
- The high bacteria activity and quantity give naturally the advantage to drown out the unwanted microflora.
- Meatferm are optimized for different fermentation temperatures and joking with temperature same starter can be used for fast, medium and slow fermenting process

Section 7

Pocket identification

7.1 Pocket description and identification

The diagram shows a white rectangular pocket with a red vertical bar on the left side containing the word "MEATFERM" in white capital letters. The pocket contains the following text:

- FCC**
- 1 U**
- LOT. : 13153
- PROD. : 040913
- EXP. : 09/2014
- After receipt
keep the pocket
at - 18 °C or lower
- biochem s.r.l.
Biochemical research center
- BIOCHEM S.r.l.
Via F.lli Rosselli, 38
00015 Monterotondo (Roma)
Tel (+39) 0774 631624
Fax (+39) 0774 631086
www.biochemsrl.it - info@biochemsrl.it

Four red arrows point from the pocket to four identification boxes:

- From "FCC" to: Product name identification : **F**ast **C**urvatus **C**arnosus
- From "1 U" to: Dosage : **1U** = dosage for 100 kg of meat
- From "LOT. : 13153", "PROD. : 040913", and "EXP. : 09/2014" to: Pocket identification : **Lot**, Date of **Production** , **Expiry** date at - 18 °C
- From "After receipt keep the pocket at - 18 °C or lower" to: Pocket storage condition



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Section 8

Meatferm product range

8.1 Meatferm acidifying culture, composition, application and characteristics.

Meatferm acidifying cultures			
Cultures	Composition	Application	Characteristics
SLS	<i>Lactobacillus sakei</i>	Slow fermentation process for the production of fresh or half-fermented sausages for increase products shelf life.	This culture have the characteristics to develop under low temperature conditions and has a positive influence against contaminants initially present in raw materials and processing. The action of the selected strain that compose this culture has a very good influence on color maintain and and help on natural pH dropping down of meat products .
MSC	<i>Staphylococcus carnosus</i>	Slow fermentation process for the production of all kinds of fermented sausages where is required flavour and colour formation.	Strong flavor and color formation starter culture with high enzymatic activity that prevent lower residual levels of nitrates and nitrites and prevent the rancidity with the development of a stable and intensive color accompanied by the formation of aroma. This starter have medium acidifying activity.
MCC	<i>Staphylococcus carnosus</i> <i>Lactobacillus curvatus</i>	Fast fermenting process for all kinds of fermented sausages where is required medium acidifying activity and aroma formation.	Medium acidifying flavor forming starter culture. The synergic action of the selected strain that compose this culture give to finished products excellent taste accompanied by the formation of color and mild taste. The medium acidifying activity of this culture permit a simple and reliable control of final product pH and permit the use of this product both in traditional that in fast fermenting sausage making.
FCC	<i>Lactobacillus curvatus</i> , <i>Staphylococcus carnosus</i>	Very fast fermenting process for all kinds of industrial fermented sausages where is required high acidifying activity and low aroma formation.	High acidifying lactic acid forming starter culture. The synergic action of the selected strain that compose this culture give to finished products fast pH dropping with excellent taste. The high acidifying activity of this culture permit a fast and reliable control of final product pH and can be used in substitution of GDL (glucono delta lactone).



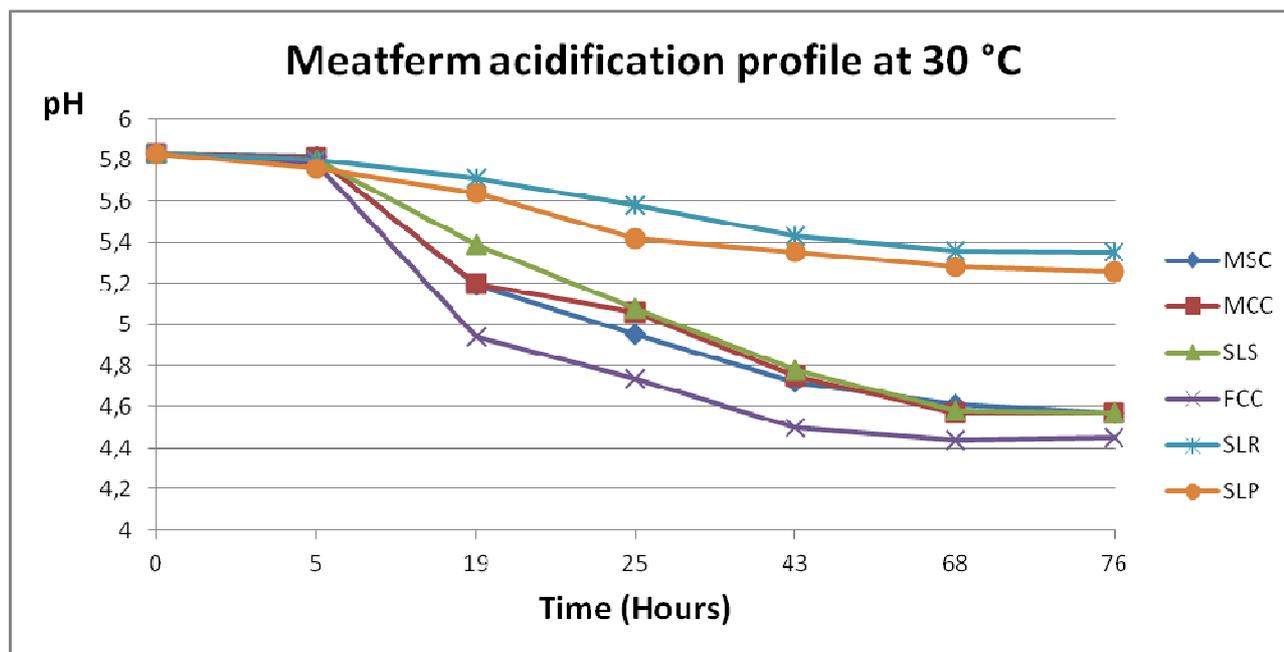
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8.2 Meatferm protective culture , composition, application and characteristics.

Meatferm protective cultures			
Cultures	Composition	Application	Characteristics
SLR	<i>Lactobacillus rhamnosus</i>	Production of fresh or half-fermented sausages for increase products shelf life. This culture can be used can be used both individually and in association with other acidifying meat starter culture	This culture have very slow acidifying characteristics and has a positive influence against contaminants initially present in raw materials and processing. The action of the selected strain that compose this culture has a very good influence again yeast and moulds and doesn't alter final pH and flavor of meat products.
SLP	<i>Lactobacillus plantarum</i>	Production of fresh or half-fermented sausages for increase products shelf life. This culture can be used can be used both individually and in association with other acidifying meat starter culture	This culture have very slow acidifying characteristics and has a positive influence against contaminants initially present in raw materials and processing. The action of the selected strain that compose this culture has a very good influence again <i>Listeria monocytogenes</i> development and doesn't alter final pH and flavour of meat products.

8.3 Meatferm acidification profile



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Section 9

How to use meatferm starter culture

9.1 Single dose pocket easy to use

Meatferm starter culture are conceived in single dose pocket easy to use.

On every pocket is indicate the dosage expressed in unit, Every unit represent 100 kg of meat to be worked .

The modality of packaging in single pocket easy to use prevent production errors and help the sausage maker in a simple way of working.

9.2 How to use the product

Meatferm starter culture are conceived for Direct Meat Inoculation (DMI) , no reactivation of the powder is need . Meatferm powder have to be added in any case at the first step of process manufacturing and specially during ingredients mixing .

In all the procedure is necessary to use all the content of the pocket and to dissolve it homogeneously in the mixing.

Before use take the culture from the freezer and use a sanitising agent to sanitise both the upper side of the packet and the tool used to open it.

There are two modality of use depending on the producer practice manufacturing:

- **Dissolve directly in the raw materials all the pocket content before mixing procedure.**
- **Rehydrate the powder in 100 ml of cold water free from chlorine and add this solution at raw material before mixing procedure** (this method help the manufacturer in the melt of culture with raw material).



Meatferm



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