LIPOLYSIS IN MEAT MODEL SYSTEMS

P.M. Kenneally[1,2] , R.G. Leuschner[1,2] , E.K. Arendt[1]

1. Department of Food Technology , 2. National Food Biotechnology Centre, University College, Cork, Ireland .

Keywords: Fermented Sausages, Lipolysis, Free Fatty Acids, Flavour

Background

Fermented foods are defined as palatable products which are prepared from raw or heated materials and which acquire their characteristic properties by a process which involves micro-organisms. In certain cases the endogenous enzymes of the raw material play a decisive role (Buckenhuskes 1993). The typical flavour of dry sausage is due to products originating from fermentation of carbohydrates, lipolysis and lipid oxidation, proteolysis, seasonings and curing salts (Verplaetse 1994). Lipolysis may originate from endogenous meat enzymes or starter cultures. Free fatty acids are produced through hydrolyzing triglycerides (Johansson et al., 1993). This lipolytic process seems to be very important for the volatile aroma fraction because it delivers the precursors for aldehyde and ketone formation (Melgar et al., 1990). Therefore free fatty acids are important flavour precursors in fermented sausages and the ability of bacterial strains to produce these acids from triglycerides can have a bearing on the overall flavour of the fermented sausage.

Objective

The objective of this study was to investigate the lipolytic ability of 24 bacterial strains on agar plates as well as in meat model systems .

Experimental Design

The 24 strains of bacteria which comprised of 12 strains of *Staphylococcus* , 3 strains of *Micrococcus* , 7 strains of *Lactobacillus* and 2 strains of *Pediococcus* were initially screened for lipolytic activity using tributyrin agar and spirit blue agar. Filter sterilized supernatant was also examined as an indication of the strains ability to produce extracellular lipases. 22 of the strains were then tested for lipolytic activity in a sterile model system consisting of 10g Tryptone, 5g Yeast extract, 5g NaCl, 1g Glucose and 40g of backfat per litre using the copper soaps method. As a control lipolysis was also measured in the sterile model system. One of the strains which was found to be positive for lipolytic activity was then analysed for its optimum conditions of lipolytic activity. Lipolytic activity was analysed at pH 3-10, temperature 4-37°C, NaCl 0-10% again using the copper soaps method. Increase in free fatty acids under optimum conditions was also measured using Gas Chromatography .

Materials and Methods

- Detection of lipase activity using tributyrin agar
- Detection of lipase activity using spirit blue agar
- Measurement of total free fatty acids by copper soaps method (IDF Standard)
- Analysis of free fatty acid profile by gas chromatography using the method of Martinez Castro et al., (1986)

Results and Discussion

Of the 24 strains initially screened for lipolytic activity using the agar methods 12 strains of *Staphylococcus* and 3 strains of *Micrococcus* were found to be positive for lipolytic activity on tributyrin agar but none of the Lactobacilli or Pediococci were found to be lipolytic, similarly on spirit blue agar only 6 strains of *Staphylococcus* and 1 strain of *Micrococcus* were found to be positive for lipolytic activity and again none of the Lactobacilli or Pediococci were found to show lipolytic activity (Table 1).
Lipolytic activity in the filter sterilized supernatant was not observed in any of the 24 strains. 6 strains of *Staphylococcus* and 1 strain of *Micrococcus* were found to be positive for lipolytic activity in the model system (Table 1).
The strain chosen for further testing was *Staphylococcus xylosus* CM-258, and it's optimum conditions for lipolytic activity were found to be pH 7.0 (Figure 1), temperature 30°C (Figure 2), and NaCl 0-1% (data not shown).
An increase in free fatty acids particularly C16:0,C16:1,C18:0,C18:1,C18:2 was also observed under optimum conditions using Gas Chromatography.

Conclusions

- It can be seen from table 1 that of the bacterial strains tested, all of the strains which were positive for lipolytic activity belonged to either the species of *Staphylococcus* or *Micrococcus* .
- While optimum lipolytic activity was obtained at 30°C, pH 7.0, and 0-1% NaCl, significant lipolytic activity was also observed at pH 5.0, temperature 20°C, and 3% NaCl which reflects the strains lipolytic ability under normal sausage conditions.

Cited Literature

Buckenhuskes, H.J. (1993). Selection criteria for lactic acid bacteria to be used as starter cultures for various food commodities.FEMS Microbiology Reviews 12 pp 253-272.
Copper soaps method (1985) IDF standard 50 B /1985 - Milk and Milk products - methods for sampling. Bulletin of the IDF 265 pp 38-40.
Johansson,G.,Berdague,J.L,Lasson,M.,Tron,N.,&Borch,E. (1993). Lipolysis, proteolysis and formation of volatile components during ripening of a fermented sausage with Pediococcus pentosaceus and Staphylococcus xylosus as starter cultures Food biotechnology-A Nordic research programme, p.72.
Martinez-Castro, I., Alanso,L. and Juarez,M. (1986). Gas chromatographic analysis of free fatty acids and glycerides of milk fat using tetramethylammonium hydroxide as catalyst. Chromatographia 21 pp 37-40.
Melgar,M.J.,Sanchez-Monge,J.M.,& Bello,J.(1990). A study of the changes in the chemical properties of fat during ripening of dry spanish sausage. J. of food composition and analysis, 3:73-80.
Verplaetse,A. (1994). Influence of raw meat properties and processing technology on aroma quality of raw fermented meat products. 40thICoMST,The Hague, Netherlands.

ACKNOWLEDGEMENTS This work was supported by the Department of Agriculture, Food and Forestry, Dublin, Ireland. We would like to thank Karen Galvin, and Esther Mc Sweeney, Department of Nutrition, University College Cork, Ireland, for their assistance in this project.

Table 1 RESULTS OF PRELIMINARY SCREENING FOR LIPOLYTIC ACTIVITY IN 24 STRAINS

	WHOLE SUSPENSION		SUPERNATANT		MODEL SYSTEM	ORIGIN OF
	TBA	SBA	TBA	SBA	COPPER SOAPS	STRAIN
STRAIN						
P.pentosaceus (PC-1)	-	-	-	-	-	CH Denmark
P.acidilactici (PA-2)	-	-	-	-	-	CH Denmark
L.pentosus (LP-1)	-	-	-	-	-	CH Denmark
L.pentosus (03A)	-	-	-	-	-	RM Germany
L.pentosus olivarum	-	-	-	-	-	RM Germany
L.plantarum (L74)	-	-	-	-	-	RM Germany
L.alimentarius (BJ-33)	-	-	-	-	-	CH Denmark
L.sake (LS-25)	-	-	-	-	-	GW Germany
L.curvatus (LB-1)	-	-	-	-	-	GW Germany
S.carnosus (SC1)	+	-	-	-	-	CH Denmark
S.carnosus (MC-ES)	+	-	-	-	+	CH Denmark
S.carnosus (MC-1)	+	-	-	-	+	CH Denmark
S.carnosus (M 3)	+	-	-	-	-	CH Denmark
S.carnosus (M 17)	+	-	-	-	-	CH Denmark
S.xylosus (K 4)	++	+	-	-	N/A	CH Denmark
S.xylosus (K-2 3)	+	-	-	-	N/A	CH Denmark
S.xylosus (CM-258)	++	+	-	-	+++	CH Denmark
S.xylosus (DD-34)	++	+	-	-	+++	CH Denmark
S.xylosus (4)	+++	++	-	-	+	N Switzerland
S.xylosus (6)	+++	++	-	-	+	N Switzerland
S.xylosus (7)	+++	+++	-	-	+	N Switzerland
M.varians(4)	+	-	-	-	-	N Switzerland
M.varians (13)	++	+	-	-	+	N Switzerland
M.varians (20)	+	-	-	-	-	N Switzerland

+=weak activity, ++=medium activity, +++=strong activity, N/A= not analysed
Strains were kindly provided by CH=Christian Hansens, N=Nestec, GW=Gewürzmüller, RM=Rudolf müller

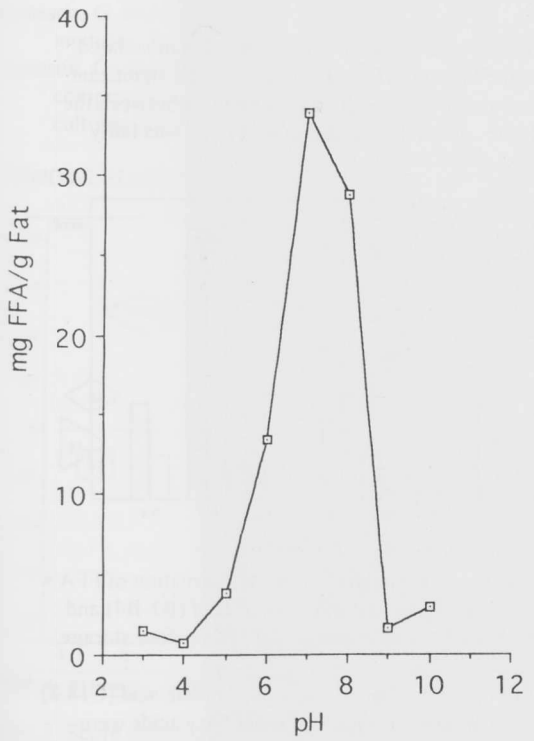

Fig.1 Lipolytic activity of S.xylosus CM-258 at various pH's

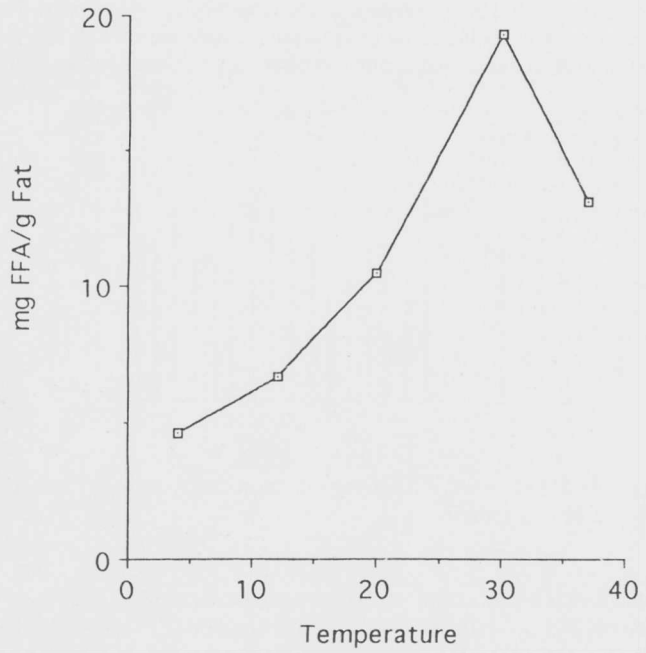

Fig.2 Lipolytic activity of S.xylosus CM-258 at various temperatures (degrees celsius)