CHAPTER 4 - RESULTS

4.1 PHASE 1 - EMC PRODUCTION

4.1.1 Microbiological safety

Table 10 Pathogen and total plate counts for a CEMC sample

Test type	Count* (cfu/g)
Total plate count	1000
Coliforms	<10
Escherichia coli	0
Staphylococcus aureus	0
Bacillus cereus	100
Clostridium perfringens	0
Salmonella	0

*Detection limit is 10 cfu/g

Table 10 shows that negative pathogen results were obtained for all but *Bacillus cereus*, which accounted for 10% of the total plate count.

4.2 PHASE 2 - CHEMICAL ANALYSIS

4.2.1 FAN plot

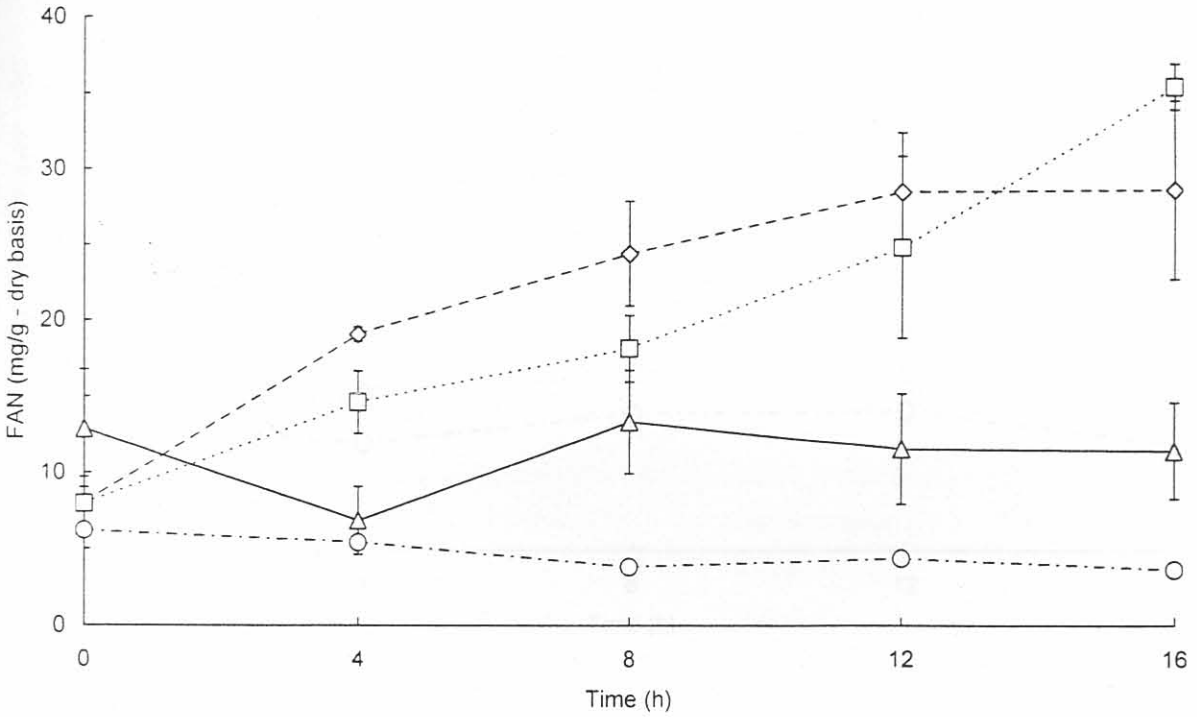

Figure 4 Effect of lipase and protease addition on FAN production from Cheddar curd. Mean FAN concentrations including standard error bars are plotted against time: control (○), protease only (□), lipase only (Δ) and lipase and protease (◊).

When protease was added to the curd there was an increase in FAN with incubation time. No increase in FAN occurred in the control (no enzyme added) or with lipase addition, although FAN levels were generally higher when lipase was added together with protease.

4.2.2 FFA plot

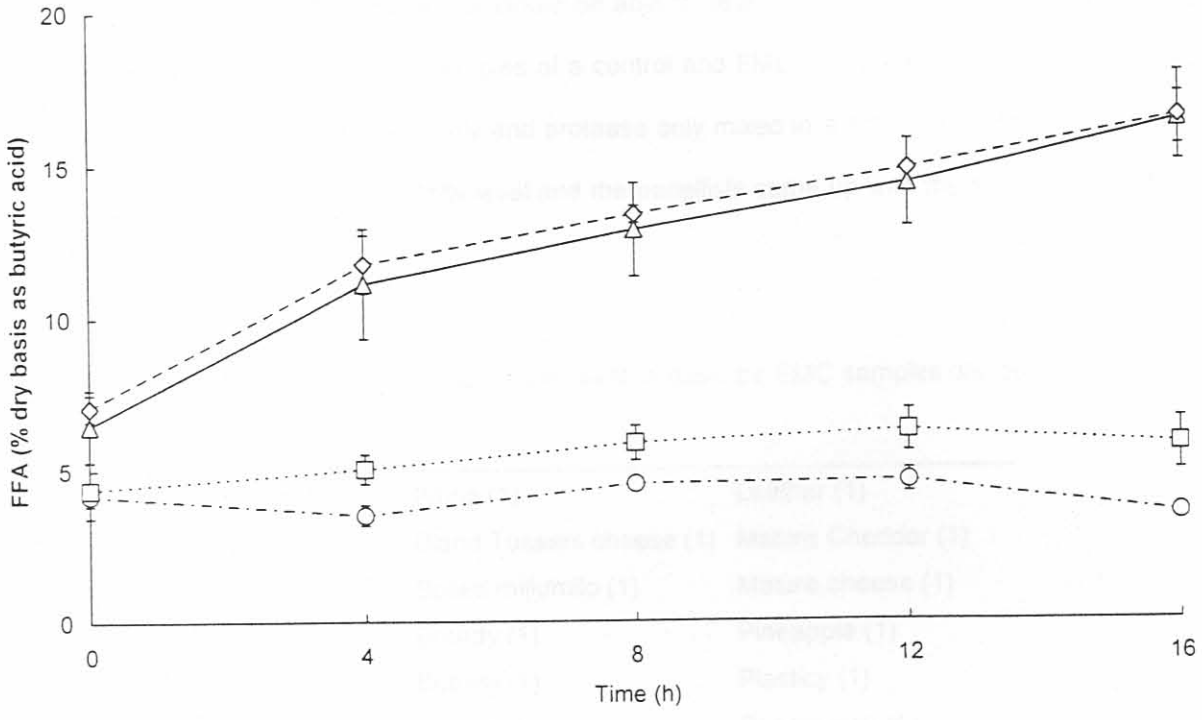

Figure 5 Effect of lipase and protease addition on FFA production from Cheddar curd. Mean FFA concentrations including standard error bars are plotted against time: control (○), protease only (□), lipase only (Δ) and lipase and protease (◊).

When lipase was added to the curd, there was an increase in FFA with incubation time. No increase in FFA occurred in the control (no enzyme added) or with protease addition, although FFA levels were generally higher when protease was added together with lipase.

4.3 PHASE 3 - SENSORY ANALYSIS

4.3.1 Lexicon determination

Initially it was thought that the panellists would be able to develop their own lexicon. As part of their training they were given unlabeled samples of a control and EMC made with lipase only, lipase and protease, protease only, and lipase only and protease only mixed in a 1:1 ratio. All the samples were diluted in an umami soup at the 1.75% level and the panellists came up with the terms listed in Table 11.

Table 11 Flavour descriptors used by taste panellists to describe EMC samples diluted in a savoury base

Butyric acid/vomit/sicky (5)*	Biting (1)	Leather (1)
Bitter (4)	Bland Tussers cheese (1)	Mature Cheddar (1)
Creamy (4)	Boiled milk/milo (1)	Mature cheese (1)
Fruity/pineapple (4)	Bready (1)	Pineapple (1)
Cheesy (3)	Buttery (1)	Plasticy (1)
Cooked/cooked milk (3)	Cereal (1)	Rancid milk (1)
Salty (3)	Cheddary (1)	Raw floury pasta (1)
Sweet milk (3)	Chicken soup (1)	Ripe (1)
Blue (2)	Choking (1)	Rooty (1)
Goaty (2)	Croutons (1)	Sharp (1)
Mouldy / mouldy cheese (2)	Decayed veg (1)	Smelly feet (1)
Mushroom / mushroom soup (2)	Earthy (1)	Spinach (1)
Processed (2)	Eggy (1)	Umami/rounded (1)
Rounded (2)	Fatty (1)	Wet dog smell (1)
Sweet (2)	Fermented vomit (1)	
Waxy (2)	Hydrolysed Veg. Protein(1)	

*Number of panellists who selected the item

Most of the terms can be consolidated into Heisserer & Chambers's lexicon (Heisserer & Chambers, 1993) as was done in this study. Their comprehensive study on what descriptors and their relevant references were suitable for taste testing cheeses was used.

4.3.2 Panellists consistency

Table 12 Mean standard error of panellist scores across all samples and descriptors

Panellist	Mean standard error
BW	0.0273
DO	0.0289
MC	0.0321
BS	0.0391
NS	0.0438
LT	0.0545

The mean standard errors for the panellists were of similar magnitude, with a range of 0.027-0.055. BW was the most consistent taste panellist while LT was the least consistent.

4.3.3 Sensory profile

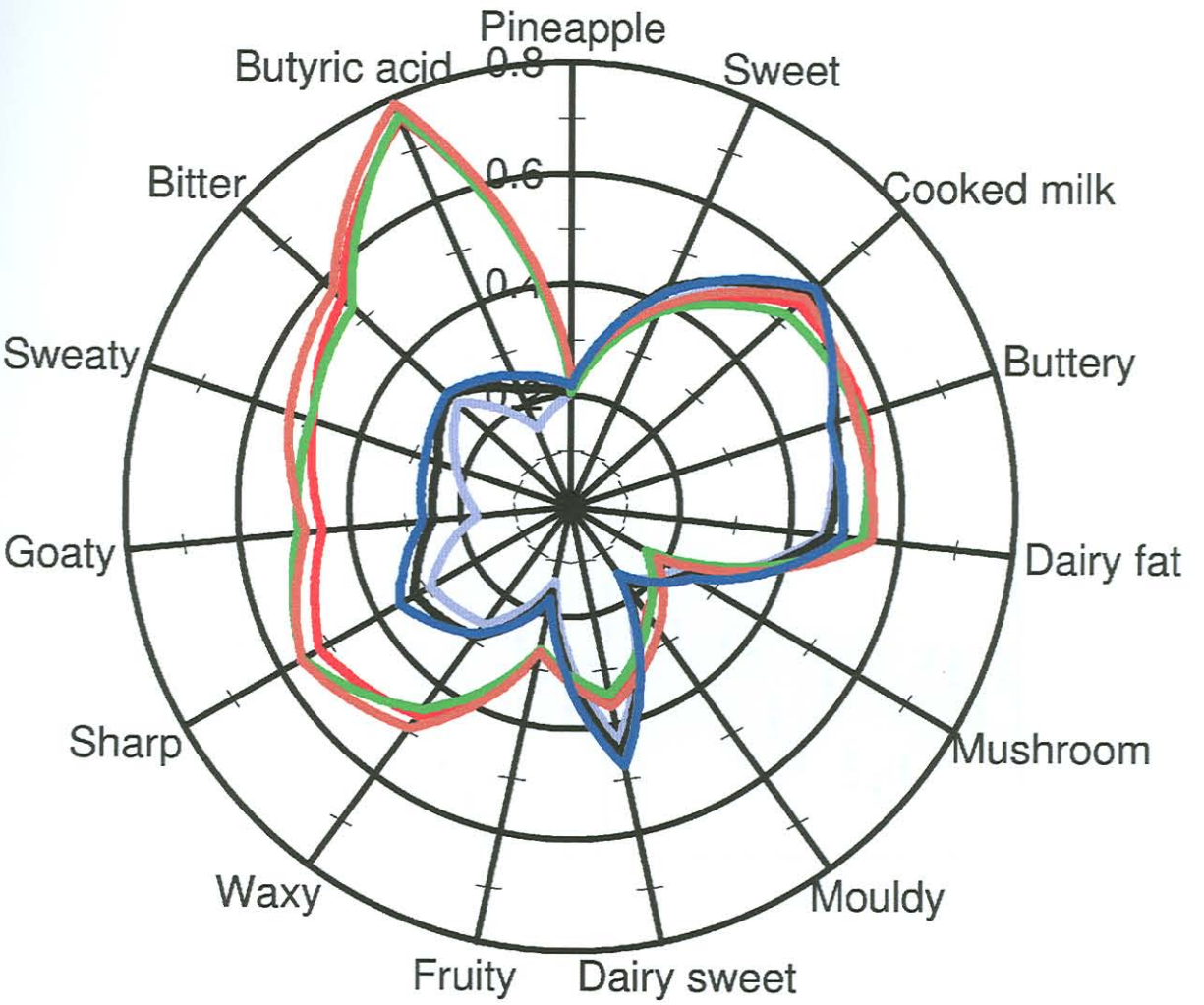

Figure 6 Comparison of sensory profiles of EMCs made with added protease and lipase, diluted in an umami soup: curd control (—), protease only (—), lipase only (—), lipase and protease (—), 1:1 blend of lipase only & protease only (—) and sensory control - soup only (—). The mean dimensionless flavour scores for each descriptor and product were plotted clockwise with increasing standard error between the samples.

The flavour wheel shows that Pineapple had the least variation across the samples whereas butyric acid had the greatest variation. The lipase-treated samples clearly followed the same trend, which was distinctly contrasted from the non-lipase-treated samples. For most descriptors the lipase-treated products scored higher than did those not treated with lipase. Little difference was observed between the products containing no added lipase, but Soup did tend to have lower scores than P and Control for Sharp, Goaty, Sweaty and Butyric acid.

4.3.4 Plot of descriptor error bars

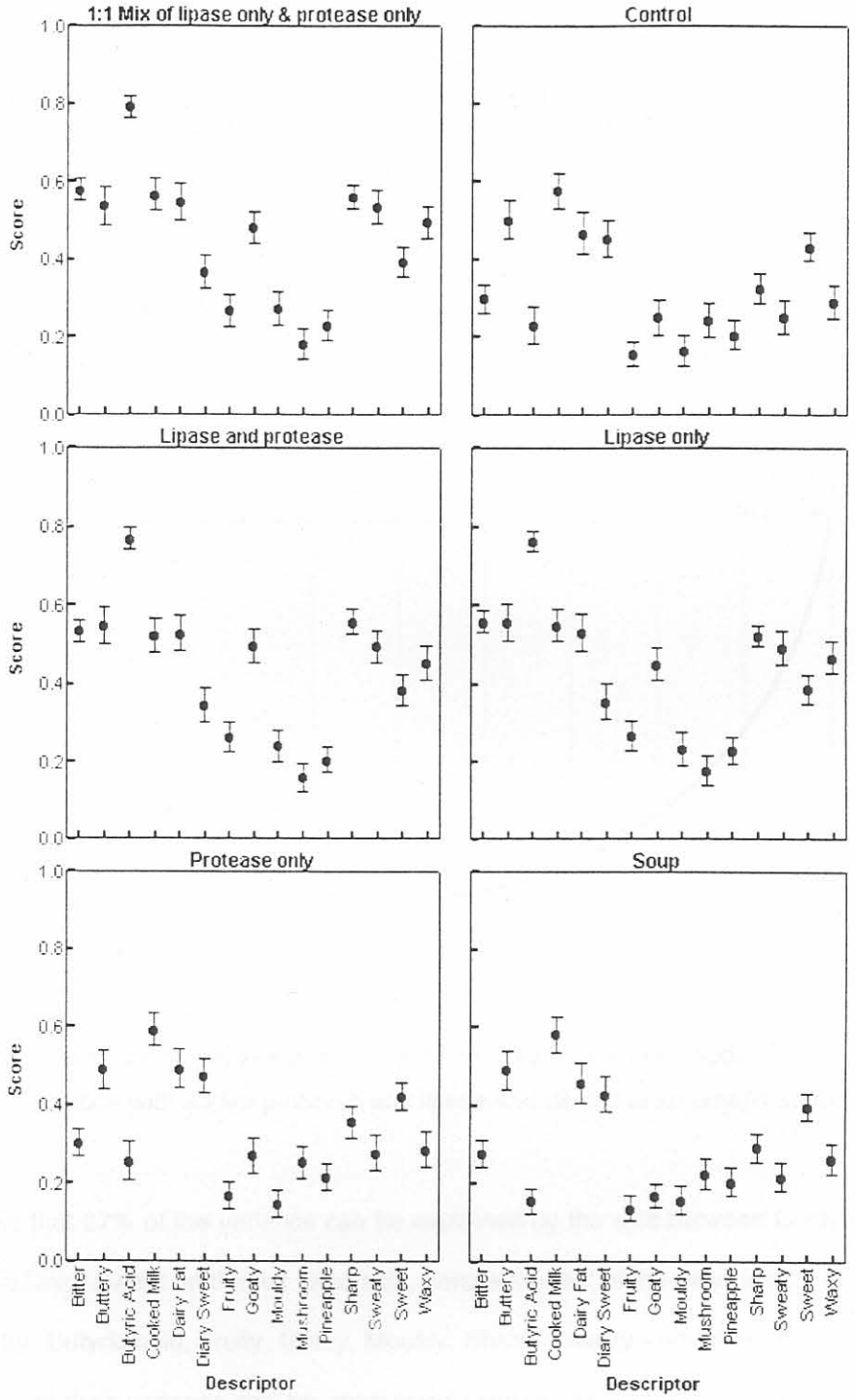

Figure 7 Comparison of the standard errors of the flavour descriptors used in the sensory profiling of EMCs made with added protease and lipase and diluted in an umami soup.

The majority of the error bars for the descriptors were of the same magnitude and the error bars for some descriptors overlap for all samples, e.g. Goaty and Sweaty.

4.3.5 Principal component analysis

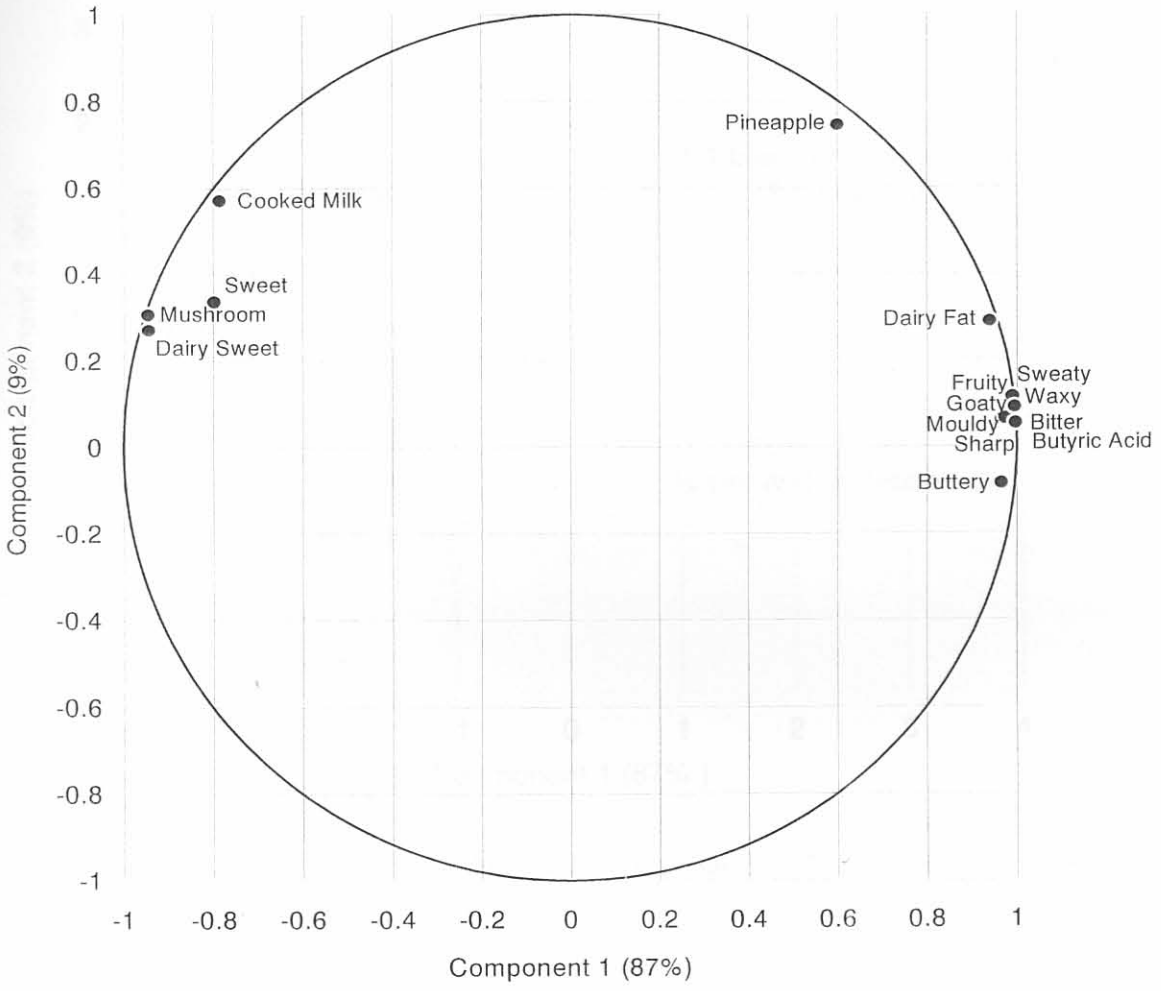

Figure 8 Principal component analysis plot of flavour descriptor variance used in the sensory profiling of EMCs made with added protease and lipase and diluted in an umami soup.

Figure 8 shows that 87% of the variance can be explained by the split between Cooked Milk, Sweet, Mushroom and Dairy Sweet on the left hand side, versus the rest of the descriptors on the other side. The terms Bitter, Butyric acid, Fruity, Goaty, Mouldy, Sharp, Sweaty and Waxy are all grouped close to each other and their variance can be considered identical as compared to the other descriptors. The differentiation on the second axis that explains 9% of the variance is less marked with Buttery showing a negative correlation as compared to the other descriptors that show a positive correlation.

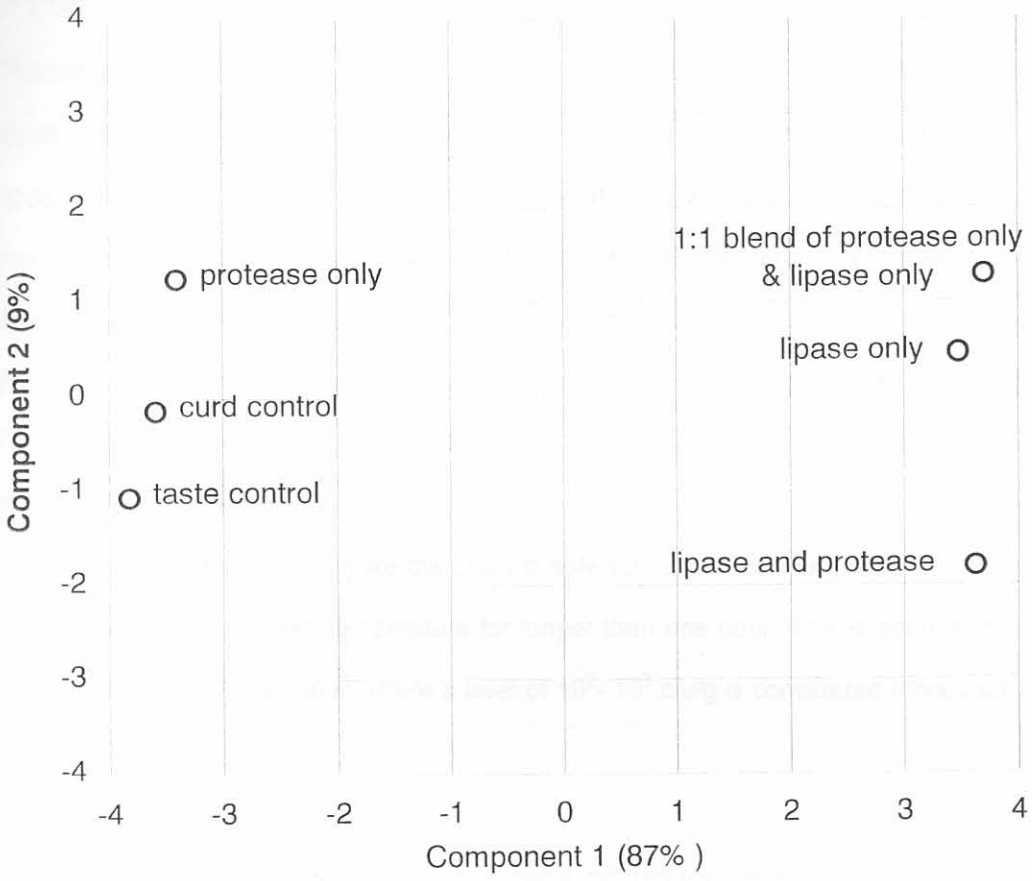

Figure 9 Principal component analysis plot of the flavour variance of EMCs made with added protease and lipase and diluted in an umami soup.

EMCs can be divided into two groups: those with protease only, curd control and taste control on the left (with a negative effect of component 1) and 1:1 blend of lipase only and protease only, lipase only and lipase and protease on the right (positive effect of component 1) and this division explains 87% of the variance. The 9% of variance accounted for by component 2 is less marked but is acting most strongly on lipase and protease.