The use of grape must in the elaboration of yoghurt. Changes of carbohydrate composition during manufacture

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1. Introduction

The Mediterranean countries of Europe produce grapes in excess. During recent years, much attention has been directed to new ways for a profitable utilisation of grape must. Since it is an excellent source of monosaccharides, must could be used as sweetener in the food industry.

One method of manufacturing plain and fruit-flavoured yoghurt involves the addition of sweeteners to the base mix before fermentation. The presence of these ingredients may affect yoghurt fermentation, especially acid production (2), culture growth (2, 8) and proteolysis (6).

The purpose of this study was to determine the effect of must addition on acid development and sugar utilization by starter microorganisms during the manufacture of yoghurt.

2. Materials and methods

2.1 Yoghurt preparation

The yoghurt mix consisted of whole milk fortified with skimmed milk powder to give a total solids-not-fat content of 13 %. The milk base was heated to 85°C for 30 min, cooled to 42°C. Then a desired amount of pasteurised must (heated at 85°C for 30 min) was added. The must came from Muscatel grape, which contained 260 g/l of total sugars.

500 ml of must-sweetened yoghurt base were inoculated with a 3 % mixture of *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus salivarius* ssp. *thermophilus* (1:1). Incubation was carried out in a 42°C water bath for 4 h. Bottles of yoghurt were removed from the incubator at 1 h intervals. The pH and carbohydrate composition were determined in duplicate for each sample. Three different lots of yoghurts were analyzed.

2.2 Quantitative analysis of carbohydrates by gas chromatography

One millilitre of yoghurt was mixed with 0.5 ml of 0.5 % phenyl-β-D-glucoside in 60 % methanol. This mixture was diluted to 5 ml with methanol, maintained for 1 h at room temperature and filtered. Then 1 ml of filtrate was evaporated until dryness under vacuum at room temperature and converted to trimethylsilyl derivatives using trimethylsilylimidazole as reported by (3).

Gas chromatographic analysis was performed on a Sigma 3B gas chromatograph (Perkin Elmer) equipped with a 3 m x 1.0 mm i.d. stainless steel column packed with 2 % OV-17 in non-silanized 120/140 Volaspher A-2 (Merck). The temperature of injector and detector was 300°C. The analysis was performed using temperature programming from 180 to 270°C at a heating rate of 5°C/min. with an initial holding time of 5 min.

2.3 Sensory evaluation

Sensory evaluation of the milk samples was carried out following the triangle test by a sensory panel of 12 trained members.

Must-sweetened yoghurts were compared with 5 % sucrose-sweetened yoghurts or with plain yoghurts. Samples were in 2 groups of 3 samples each, distributed so that in each group 2 samples were identical, and another was different, in a randomized order. Panelist were asked to identify the odd sample. Results were subjected to a t-test statistical analysis.

3. Results and discussion

The pH value of the concentrated must was 2.4. Therefore, the higher the added must content, the lower the pH of the base mix, although small differences were observed at the end of incubation, the final pH values being in the range of 3.9 – 4.1, see Table 1.

Table1: Changes on pH values during incubation of yoghurt made from milk fortified with 0, 5, 10 and 20 % of grape must

Incubation time (h)	Must concentration 0 %	5 %	10 %	20 %
0	6.5 (0.06)*	6.1 (0.20)	5.8 (0.28)	5.3 (0.50)
1	5.8 (0.10)	5.6 (0.25)	5.4 (0.25)	5.1 (0.40)
2	5.2 (0.30)	4.9 (0.45)	4.8 (0.40)	4.9 (0.35)
3	4.5 (0.30)	4.4 (0.38)	4.3 (0.40)	4.5 (0.30)
4	4.0 (0.40)	3.9 (0.45)	3.9 (0.35)	4.1 (0.20)

*Media (standard deviation), n = 3.

The pH decrease however, was lower in mixtures with the highest sugar concentration. This may be related to the a_w reduction and also to the low initial pH, which may have deviated from the optimum for growth of the thermophilic lactic acid bacteria.

Fig. 1 shows lactose utilization by the yoghurt microorganisms and galactose accumulation during the 4 h of incubation. The initial lactose concentration was lower in yoghurts with 10 and 20 % of must. A progressive decrease of lactose content was observed, the lactose decrease was lower in yoghurts containing the highest concentration of must. This observation coincides with the low variation in the pH values observed.

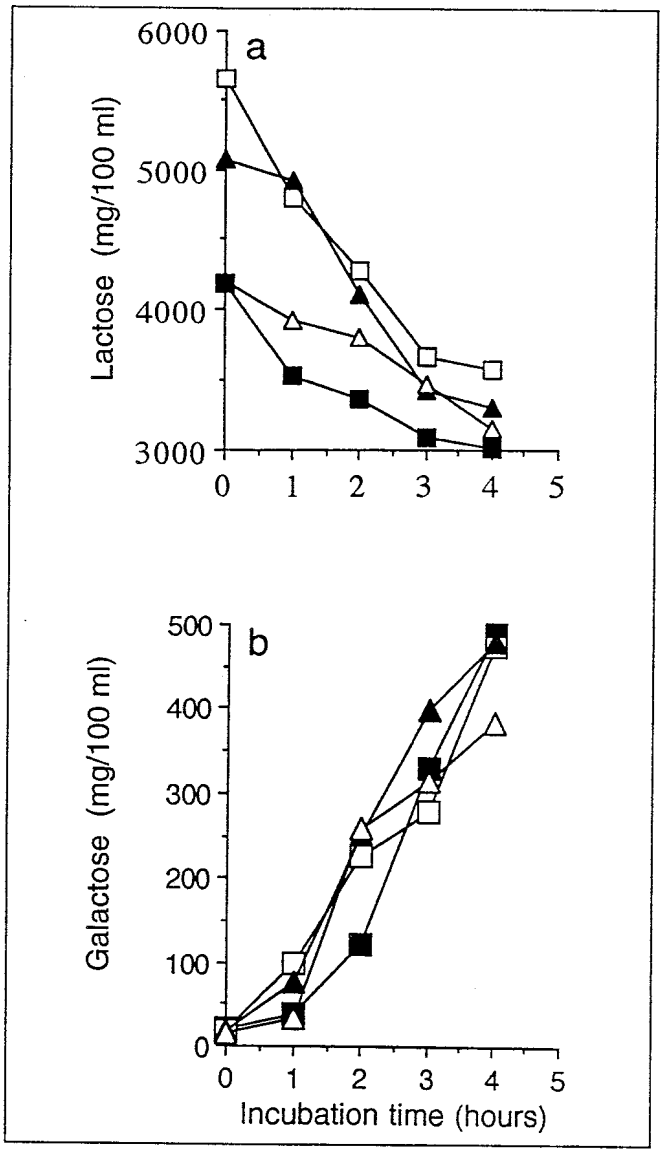

Fig. 1: Changes in lactose (a) and galactose (b) content during incubation of yoghurts made from milk fortified with 0 (■), 5 (❑), 10 (Δ) and 20 % (▲) of grape must.

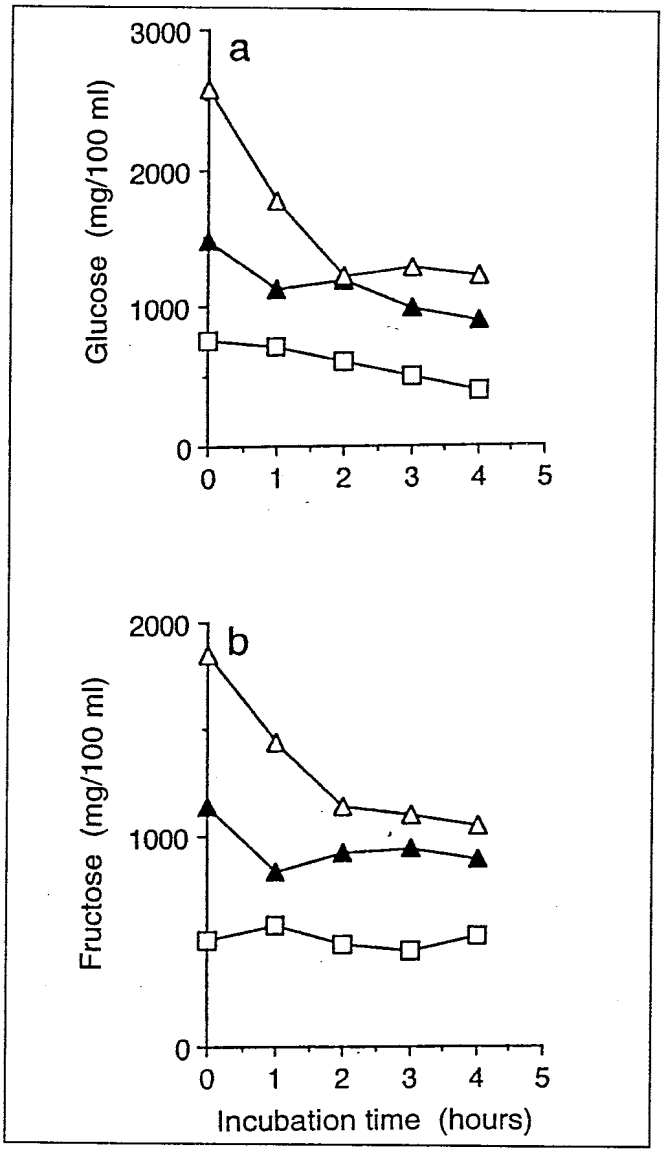

Fig. 2: Changes in glucose (a) and fructose (b) content during incubation of yoghurts made from milk fortified with 5 (❑), 10 (Δ) and 20 % (▲) of grape must.

In all cases galactose content increased progressively with time, which is in agreement with previous reports about carbohydrate metabolism by thermophilic lactic acid bacteria (1, 4). However, as the concentration of galactose was lower than expected, this seems to indicate that a partial metabolism of galactose could have occurred.

Variations in the concentration of glucose and fructose during incubation are shown in Fig. 2. Low concentration of glucose, 0.25–1.95 mg/100 ml, was found in plain yoghurt. A significant decrease in the concentration of glucose and fructose was not observed except in the batch fortified with 20 % of must. It is possible that this is related to the preferential utilization of disaccharides over monosaccharides (5). This is probably due to an increase in the β-galactosidase activity when lactose is present in the medium (7).

Sensory analysis showed that no differences in sweetness could be detected between yoghurts with 5–10 % of added must and conventional plain yoghurt. No significant differences were detected between yoghurt sweetened with 5 % of sucrose or with 20 % of must.

It appears that fortification of milk with grape must for yoghurt manufacture could be a useful procedure to minimize the excess of must existing nowadays in Mediterranean countries.

4. References

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5. Summary

CALVO, M.M., ORDOÑEZ, J.A., OLANO, A.: **The use of grape must in the elaboration of yoghurt. Changes of carbohydrate composition during manufacture.** Milchwissenschaft **50** (9) 506–508 (1995).

62 Yoghurt (grape must)

Grape must can be used as a sweetener in the manufacture of yoghurts. The time required to reach pH 4.0 decreased, as the concentration of must increased. Yoghurt starters can utilize lactose, glucose and fructose simultaneously. The lactose consumption by the starter was lower in yoghurts containing the highest concentration of must. The consumption of glucose and fructose increased with increasing must concentration. Sensory analysis showed no significant differences between samples with the addition of 20 % of must and those with 5% of sucrose.

CALVO, M.M., ORDOÑEZ, J.A., OLANO, A.: **Die Verwendung von Traubenmost bei der Herstellung von Yoghurt. Veränderungen der Kohlenhydratzusammensetzung während der Herstellung.** Milchwissenschaft **50** (9) 506–508 (1995).

62 Joghurt (Traubenmostzusatz)

Traubenmost kann als Süßungsmittel bei der Herstellung von Joghurt verwendet werden. Die für das Erreichen eines pH-Wertes von 4,0 erforderliche Zeit sank mit zunehmender Mostkonzentration. Joghurt-Säurewecker können Laktose, Glukose und Fruktose gleichzeitig verwenden. Der Laktoseverzehr durch den Säurewecker lag in Joghurts mit der höchsten Mostkonzentration am niedrigsten. Der Glukose- und Fruktoseverzehr stieg mit zunehmender Mostkonzentration an. Die sensorische Analyse zeigte keine signifikanten Unterschiede zwischen Proben mit 20% Most und solchen mit 5 % Saccharosezusatz.

Untersuchungen zum Übergang ausgewählter polychlorierter Dibenzo-para-dioxine und -furane (PCDD/F) nach oraler Supplementierung in die Milch laktierender Kühe

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1. Einleitung und Aufgabenstellung

Eine fundamentale stoffliche Eigenschaft für das Umweltverhalten der PCDD/F ist, mit Ausnahme der Photolyse, ihre enorm hohe Abbauresistenz verbunden mit guter Löslichkeit in apolaren Medien. Dies führt zwangsläufig bei nahezu ubiquitärer diffuser Belastung der entsprechenden Pfade zu einer Akkumulierung in den höheren Gliedern der Nahrungskette (Nutztier und Mensch). Die Exposition des menschlichen Verbrauchers erfolgt zu mehr als 90 % über die Nahrung. Innerhalb der Lebensmittel wiederum sind die vom Tier stammenden fetthaltigen Produkte Milch, Fleisch, Eier und Fisch mit großem Abstand die eigentlichen Träger der Dioxin-/Furanzufuhr.

Der hohe Anteil der Lebensmittel tierischen Ursprungs an der täglichen Zufuhr mit etwa einem Drittel der beigesteuerten toxischen Äquivalente allein aus dem Milchfett, verbunden mit der inzwischen bekannten überragenden Bedeutung des Luftpfades bei der Dispersion und Deposition der PCDD/F in die Umwelt und (auch) auf Futterpflanzen, macht die Carry over-Forschung zur Erfassung des Übergangs der toxischen Äquivalente aus der Futterpflanze in Milch und Organe/Gewebe des Nutztieres zu einem zentralen Anliegen im terminalen Abschnitt der Nahrungskette.

Die Kenntnisse zum Übergang der PCDD/F aus Futtermitteln in das Milchfett sind bislang nur aus Fallstudien unter Umweltbedingungen mit wenigen Einzeltieren abgeleitet.

Der Natur der Umweltkontaminanten entspricht es, daß Zeitpunkt des Expositionsbeginns und Konstanz der Zufuhr weitgehend unklar sind. Hinzukommt, daß in dem insgesamt 210 definierte Kongenere umfassenden Gemisch der stets vergesellschaftet vorkommenden polychlorierten Dibenzodioxine und -furane lediglich 10 Furane und 7 Dioxine die toxikologisch und ökochemisch relevante Chlorsubstitution in der 2,3,7,8-Stellung aufweisen, von denen wiederum nur 5 Kongenere mehr als 80 % der im Milchfett aufsummierten toxischen Äquivalente repräsentieren.

Aufbauend auf dieser vorab umrissenen Problematik wurden am Institut für Hygiene der Bundesanstalt für Milchforschung in Kiel Untersuchungen durchgeführt, um

- ein Konzept zur Durchführung von Supplementierungsversuchen mit PCDD/F an laktierenden Kühen im Hinblick auf eine vermehrte Information gegenüber Feldversuchen unter Umweltbedingungen zu erarbeiten sowie
- den Übergang einzelner, toxikologisch relevanter Kongenere nach oraler Supplementierung in das Milchfett in Fütterungsversuchen zu quantifizieren.