



Short Communication

The lactose and galactose content of milk fats and suitability for galactosaemia

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ABSTRACT

Introduction: Butter oil, ghee and butter are theoretically low in lactose. All three products are high in milk fat; butter oil and ghee contain approximately 99.3% fat and butter around 80% fat. We report the lactose and galactose content of butter, ghee, and butter oil and assess their suitability in a low galactose diet.

Methods: A total of 12 samples (butter oil $n = 5$, ghee $n = 5$, butter $n = 2$) were analysed by High-Performance Anion Exchange Chromatography with Pulsed Amperometric Detection (HPAEC-PAD) technology used to perform lactose and galactose analyses.

Results: Butter oil and ghee were consistently low in lactose and galactose. Butter oil analysis: lactose, 0.47 to 3.08 mg/100 g; galactose, <0.05 to 2.28 mg/100 g. Ghee analysis: lactose, <0.05 to 2.9 mg/100 g; galactose, <0.05 mg to <1.0 mg/100 g. Butter analysis: lactose 685 to 688 mg/100 g; galactose, 1.3 mg to 1.6 mg/100 g.

Conclusions: Butter oil (commonly used in food industry) and ghee contain minimal lactose and galactose and so are permitted in a UK galactosaemia diet. Butter is considered too high in lactose and is unsuitable in a low galactose diet.

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1. Introduction

Between 2009 and 2011, we reported the lactose and galactose content of a range of 15 cheese types, some of which are suitable in a low galactose diet for patients with galactosaemia [1,2]. We have extended the analysis to milk fats (butter, ghee, butter oils). These products are predominantly milk fat based and are likely to be low in lactose and galactose. Milk fats have many functional properties and are widely used in food manufacture and catering, and if suitable to incorporate into the diets of patients with galactosaemia they would increase the palatability and ease of dietary management. We report the lactose and galactose analysis of butter, ghee, and butter oil.

2. Methods

Five samples of butter oil and 3 samples of ghee were supplied by Meadows Foods and KTC respectively from 2013 to 2014. Two samples each of butter and ghee were purchased from retail outlets between 2011 and 2014. They were prepared and analysed by Leatherhead Food Research. High-Performance Anion Exchange Chromatography with Pulsed Amperometric Detection (HPAEC-PAD) technology was used to perform lactose and galactose analysis. The HPAEC-PAD had a limit of

detection of lactose and galactose of <1.0 mg/100 g for the 2011 analysis. This was further refined to <0.5 mg/100 g from the 2013 analysis onwards.

3. Results (Table 1)

3.1. Butter oil ($n = 5$ samples)

The lactose content varied from 0.47 to 3.08 mg/100 g and galactose was <0.05 to 2.28 mg/100 g.

3.2. Ghee ($n = 5$ samples)

The lactose content varied between <0.05 and 2.9 mg/100 g and galactose was <0.05 mg to <1.0 mg/100 g (the galactose content was always below the lower level of detection in three separate analyses).

3.3. Butter ($n = 2$ samples)

The lactose content varied between 685 and 688 mg/100 g and galactose was 1.3 mg to 1.6 mg/100 g.

4. Discussion

The UK Galactosaemia Support Group (GSG) Medical Advisory Panel regard that any 'cheese' with a lactose and galactose content of

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Table 1

Lactose and galactose content of butter oil, ghee and butter.

Food	Date	Lactose mg/100 g	Galactose mg/100 g
Butter oil	October, 2013	0.67	Not detected
Butter oil	October, 2013	0.83	Not detected
Butter oil	October, 2013	0.47	Not detected
Butter oil	May, 2014	3.08	0.28
Butter oil	May, 2014	2.53	0.06
Ghee	August, 2011	2.9	Not detected
Ghee	October, 2013	1.79	Not detected
Ghee	May, 2014	Not detected	Not detected
Ghee	May, 2014	Not detected	Not detected
Ghee	May, 2014	Not detected	Not detected
Butter	August, 2011	688	1.6
Butter	August, 2011	685	1.3

Lower limit of detection in 2013/2014 analysis: <0.05 mg/100 g.

Lower limit of detection in 2013/2014 analysis: <1 mg/100 g.

consistently less than 10 mg/100 g is suitable for a low galactose diet. Therefore, using the same definition, butter oil and ghee are considered safe for patients with galactosaemia. Butter is high in lactose and so unsuitable. Only two samples of butter were analysed, but from the initial testing it was clear that the lactose was present in significant amounts and was also consistent with the carbohydrate analysis of butter (0.6 g/100 g) published in McCance and Widdowson's 'The composition of Foods' [3].

The lactose and galactose content of butter oil (sometimes referred to as anhydrous milk fat) was minimal. Butter oil contains approximately 99.3% milk fat and is made by the removal of almost all the moisture and non-fat milk solids from butter or cream. It is produced by heating butter and so disrupting the butter emulsion. The milk fat is then concentrated in separators and vacuum dried to remove residual moisture. Butter oil is not available for domestic use but it is used by food industry for the following functions: flavour, flavour carrier, food gloss, creaming, air incorporation, anti-staling, and shortening. It is often used in preference to butter due to its longer shelf life. Therefore, its inclusion should widely enhance the number of manufactured foods that can be incorporated in a low galactose diet.

Ghee is clarified butter and contains approximately 99.3% milk fat and it was also consistently low in lactose and galactose. It originates from India and Pakistan and is commonly used in Kurdish, Afghani, Pakistani, Indian, Bangladeshi and Sri Lankan cooking. It is made by heating butter and removing the non-fat milk solids from the oil. Restaurants serving Asian food commonly use ghee to serve with roti or rice or incorporate it into curries or daal (lentils), or for other cooking purposes. It is used for deep frying as it has a high smoke point.

Butter is an emulsion of butterfat, water and air, made by churning fresh or fermented cream or milk. It contains approximately 80% fat, with the remainder being constituted by moisture, milk protein and lactose from the milk or cream. 10 g of butter (the amount added to 1 slice of bread) would provide almost 70 mg of lactose, delineating its unsuitability in a low galactose diet. If a patient consumed 4 slices of

bread per day, the intake of lactose would provide 280 mg/day from this source. We have little evidence to suggest that this daily amount would be safe for children and so butter is best avoided. However, interestingly, butter appeared to be low in galactose. The reason for this is not clear and further analysis may be warranted to verify this analysis.

This analysis of ghee, butter oil and butter was specifically to determine the lactose and galactose content only and not milk protein, although the milk protein content of butter oil and ghee should be lower than butter. Although there was some small variability in lactose/galactose analysis, particularly for butter oil, the amount (maximum 3 mg/100 g for 5 samples), is clinically not significant. It is known that the intake of galactose from a low galactose diet allowing fruit and vegetables will provide 17 to 54 mg/day [4,5], and these foods are permitted in the diet by many countries and are considered safe. Therefore, any trace amount of lactose and galactose provided from butter oil is inconsequential.

In conclusion, this analysis has enabled butter oil and ghee to be permitted into a low galactose diet. Both products will help expand the food choice and cuisine available to patients with galactosaemia. It is essential that any new or existing ingredients that may contain lactose/galactose are systematically analysed before inclusion in a low galactose diet.

Conflicts of interest

Anita MacDonald is a member of the Sapropterin Advisory Board and Chair of the European Nutrition Expert Committee, both groups supported by Merck Serono. She is also on Advisory Boards for Nutricia and Arla. She receives research funds from VitaFlo Ltd., Nutricia and Merck Serono.

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References

- [1] P.A. Portnoi, A. MacDonald, Determination of the lactose and galactose content of cheese for use in the galactosaemia diet, *J. Hum. Nutr. Diet.* 22 (2009) 400–408.
- [2] P.A. Portnoi, A. MacDonald, The lactose content of Mini Babybel and suitability for galactosaemia, *J. Hum. Nutr. Diet.* 24 (2011) 620–621.
- [3] M.A. Roe, P.M. Finglas, S.M. Church, McCance and Widdowson's 'The Composition of Foods', Foods Standards Agency, Cambridge, 2002 (Royal Society of Chemistry).
- [4] A.M. Bosch, H.D. Bakker, L.J.M. de Wenniger-Prick, R.J. Wanders, F.A. Wijburg, High tolerance for oral galactose in classical galactosaemia: dietary implications, *Arch. Dis. Child.* 89 (2004) 1034–1036.
- [5] G.T. Berry, M. Palmieri, K.C. Gross, P.B. Acosta, J.A. Henstenburg, A. Mazur, R. Reynolds, S. Segal, The effect of dietary fruits and vegetables on urinary galactitol excretion in galactose-1-phosphate uridylyltransferase deficiency, *J. Inher. Metab. Dis.* 16 (1993) 91–100.