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Research Article
Nutritional Aspects of Ghee Based on Lipid Composition

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Abstract

Background and Objective: Ghee is a dairy product produced from milk, cream or butter of buffalo or cow and for a long time, it has been widely consumed in Asia and the Middle East; nonetheless, in the last few years, the population of the American continent has increased its consumption. For that reason, as well as the lack of a nutritional evaluation of the dairy product, the aim of this study was to establish the fatty acid profile of ghee to define the risks and/or benefits of ghee in human nutrition and health. **Materials and Methods:** Ghee was elaborated from cow and buffalo butter using the cream butter method and the fatty acid profiles of both samples were determined using gas chromatography with flame ionization detector-GC/FID. Three batches of each type of ghee were produced and a total of eighteen samples were assessed. The data were statistically analyzed by one-way ANOVA followed by the least-significance difference test. **Results:** The main component of both ghee samples was the lipid fraction comprising approximately 99% of the product from which, 83% (cow) and 85% (buffalo) were fatty acids. The saturated fatty acids were present in the highest proportion (>50%) and palmitic, myristic and stearic acids were dominant; followed by monounsaturated fatty acids (20%), mainly oleic acid; polyunsaturated fatty acids (1.6% for buffalo and 2.6% for cow); and ruminant trans fatty acids (3.5%), where the concentration of conjugated linoleic acid (CLA) exhibited differences between cow (1%) and buffalo ghee (0.8%). **Conclusion:** According to the fatty acid profile and the review of the scientific literature, it was inferred that ghee, either from cow or buffalo milk, has no significant benefits for human nutrition due to the low CLA content and the high saturated fatty acid concentration.

Key words: Clarified butter, conjugated linoleic acid, coronary disease, dairy product, ruminant trans fatty acids

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Ghee or clarified butter is a dairy product produced by heating milk, cream or butter until complete evaporation of water and the removal of nonfat solids. This process confers a characteristic homogeneous, smooth and semisolid texture that is golden yellow in color in the case of cow ghee and white in color when the product comes from buffalo sources. The removal of nonfat solids allows free lactose and casein dairy product to be obtained[1-3].

Ghee is a traditional dairy product from the Middle East and Asia, especially India, where it is very popular due to its use in Ayurveda medicine[4]. Nonetheless, in the last few years, the use and consumption of ghee has increased around the world. According to the World-Butter and Ghee-Market Analysis, Forecast, Size, Trends and Insights, the global intake of ghee has exhibited a moderate rise since 2007[5].

The wide and increasing popularity of the product is due to the health benefits that have been granted by Ayurveda medicine. Currently, ghee is recommended as a healthy food by fitness studios, yoga centers and health stores; moreover, several web sites have defined ghee as a "super food", "the product that is revolutionizing human health", "the golden elixir" and "the fashion food", which strongly attracts the attention of consumers. Nevertheless, those terms and benefits lack scientific studies that support, verify and validate ghee benefits to human health.

Based on that, the aim of this study was to evaluate the proximate composition and fatty acid profile of two ghee samples prepared from cow and buffalo butter to determine the accurate lipid composition of the dairy product and, thus, through a literature review, establish an association between the lipid composition of ghee and the effects of its consumption on human nutrition and health.

MATERIALS AND METHODS

Materials: Cow milk was collected from La Montaña farm located in San Pedro de los Milagros, Antioquia, Colombia and buffalo milk was obtained from Vegas de la Clara farm located in Gomez Plata, Antioquia, Colombia. The chemical compounds for chromatographic analyses, such as cis/trans linoleic acid methyl ester mix, FAME mix food industry of 37 components with fatty acids from C4 to C24 (Restek), hexane, triglyceride triundecanoin, boron trifluoride and NaOH/methanol, were purchased from Millipore-Sigma.

Methods: Three batches of ghee were produced using 100 L of milk from either buffalo or cow and nine samples from each type of ghee were analyzed.

Cream extraction and butter production: Cow or buffalo milk was warmed at 40±2°C and skimmed using a centrifugal cream separator. Thereafter, cream was pasteurized at 85±3°C for 10 min and stored at 4°C for 24 h prior to churning. Cow and buffalo butters were obtained by churning cold cream in a butter-making machine and finally, the butters were packaged in vacuum packaging and stored at 4°C until ghee production. Cream extraction and butter production were carried out at the dairy plant located at Vegas de la Clara farm. Three separate batches were processed for each type of milk.

Ghee production: Cow and buffalo ghee were prepared by the cream butter (CB) method. The butter was heated at 85-100°C with occasional stirring until the evaporation of water and the development of golden-colored nonfat solids. Then, the ghee was cooled to 60°C, filtered, packed in glass containers with metal lids and stored in darkness at room temperature until chromatographic analyses. Ghee production was performed at the dairy plant located at Vegas de la Clara farm.

Chemical analyses: Buffalo and cow ghee were analyzed to quantify the proximate composition as well as the fatty acid profile. Fatty acids were assessed by chromatographic techniques to quantify the saturated (SFA), monounsaturated (MUFA), polyunsaturated (PUFA) and ruminant trans fatty acids (rTFA). The fatty acid composition was determined by analyzing the fatty acid methyl esters (FAMEs) derivatives.

Proximate composition analyses: The water content of the ghee samples was assessed by drying the samples at 105±1°C to a constant weight[6] and the protein was quantified according to the Kjeldahl method converting the nitrogen to protein using the factor 6.38[7]. The ash content was determined by calcination at 550°C until the residue was white[8] and lipids were measured by the indirect method[9].

Lipid extraction and methyl derivative preparation: Ghee samples were homogenized and then 150-200 mg was extracted with 50 mL of hexane using the Soxtec 2050 equipment with an established program (20 min of boiling, 40 min of rinsing, 10 min of recovery and 10 min of pre-drying) followed by the evaporation of hexane at 70°C. The

extracted fat was combined with an internal standard, 1 mL of 5 mg mL^{-1} triglyceride triundecanoin (>98%) and 4 mL of 0.5 M NaOH/methanol. The mixture was heated to 100°C for 10 min and then 5 mL of 7% boron trifluoride in methanol was added. The mixture was heated for another 2 min. Thereafter, 4 mL of hexane was added and the mixture was heated for 1 min. Then, it was cooled to room temperature and a saturated sodium chloride solution was added. Finally, the upper layer that contained the methyl esters was transferred to an Eppendorf vial and stored at -18°C until chromatographic analyses.

Fatty acid profile identification and quantification: The SFA, MUFA, PUFA and rTFA composition of the ghee samples was assessed by analyzing the fatty acid methyl ester (FAME) derivatives using a gas chromatograph with flame ionization detector-GC/FID (Agilent Mod. 7890B) equipped with a TR-CN100 column (60 m×250 µm ID×0.20 µm film thickness). The conditions of the GC/FID for quantifying SFAs, MUFAs and PUFAs were as follows: injector temperature 260°C, detector temperature 300°C, split ratio 100:1, helium carrier gas with a flow rate of 1.1 mL min^{-1}, injection volume 1 µL and temperature program: 90°C/7 min followed by heating at 5°C/min to 240°C/15 min. On the other hand, the chromatography conditions for the quantification of rTFAs were as follows: injector temperature 220°C, detector temperature 250°C, split ratio 50:1, helium carrier gas with a flow rate of 1 mL min^{-1}, injection volume 1 µL and temperature program: 170°C/5 min followed by heating at 5°C/min to 240°C/5 min. The identification of the FAME was performed by comparing the retention times with those of standard chromatographic standards and the quantification was performed according to the standard method[10].

Atherogenic and thrombogenic indices calculation: To assess the nutritional quality of ghee, the atherogenic index (AI), which is an indication of the tendency to produce micro- and macro-coronary diseases and the thrombogenic index (TI), as an indicator of the tendency to form clots in the blood vessels, were calculated according to equations 1 and 2 of Ghaeni *et al.*[11] and Simat *et al.*[12]

$$AI = \left[\frac{\{C12:0+(4\times C14:0)+(C16:0)\}}{(MUFA+PUFA)}\right]$$

$$TI = \left[\frac{C14:0+C16:0+C18:0)}{0.5\times MUFA+0.5\times PUFA\text{-}n6+3\times PUFA\text{-}n3+(PUFA\text{-}n3/PUFA\text{-}n6)}\right]$$

Statistical analysis: The data were analyzed using one-way ANOVA followed by a least-significance difference test to evaluate the difference between ghee samples. The statistical analyses were conducted using the free software SAS University edition.

RESULTS

The proximate composition of ghee samples is exhibited in Table 1. The moisture and lipid contents were similar in both samples ($p>0.05$). Nonetheless, the concentration of protein was higher in cow than that in buffalo ghee, while the buffalo sample showed a 2.4-fold higher ash content than that of the cow sample (Table 1).

The fatty acid profile of cow and buffalo ghee is shown in Table 2. Saturated fatty acids (SFAs) comprised 55.1 and 59.7% of cow and buffalo ghee, respectively and palmitic acid was the predominant SFA in both samples, followed by stearic and myristic acids. Furthermore, the concentrations of palmitic and stearic acids were higher in buffalo, while myristic acid was higher in cow ghee ($p<0.05$). Regarding short-chain SFAs but uric acid was the major fatty acid with higher concentration in buffalo than that in cow ghee.

The content of monounsaturated fatty acids (MUFAs) was higher in cow (22%) than that in buffalo ghee (20%), where oleic acid was the main MUFA and comprised above 90% of the MUFAs. Likewise, the polyunsaturated fatty acid (PUFA) concentration was 1.6-fold lower in buffalo than that in cow ghee. It is important to highlight that the concentration of ruminant trans fatty acids (rTFAs) is higher than that of PUFAs and in the case of buffalo ghee, it is more than 2-fold higher. Vaccenic acid was the main rTFA in both samples, comprising above 60% of rTFAs followed by the cis-9, trans-11 conjugated linoleic acid (CLA), which exhibited higher contents in cow ghee. Petroselinic and elaidic acids were present only in buffalo ghee (Table 2).

Cow ghee showed a better ratio of n-3/n-6 fatty acids than buffalo ghee. Furthermore, the latter exhibited higher atherogenic and thrombogenic indices as well. The values of the atherogenic and thrombogenic indices were the same in buffalo ghee but were different in cow ghee (Table 2). In

Table 1: Proximate composition of ghee

Ghee sample	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
Cow	0.3±0.022[a]	0.78±0.045[a]	98.9±0.80[a]	0.014±0.028[b]
Buffalo	0.3±0.016[a]	0.69±0.026[b]	99.0±0.50[a]	0.034±0.002[a]

Data are expressed as Mean±standard deviation. Different letter within a column indicates statistically difference ($p<0.05$)

Table 2: Fatty acids profile of ghee

Fatty acid	Cow ghee (%)	Buffalo ghee (%)
Butyric acid (C4:0)	1.772±0.004[b]	1.958±0.001[a]
Caproic acid (C6:0)	1.437±0.001[a]	0.861±0.002[b]
Caprylic acid (C8:0)	0.986±0.001[a]	0.410±0.002[b]
Capric acid (C10:0)	2.542±0.001[a]	0.858±0.002[b]
Lauric acid (C12:0)	3.144±0.001[a]	2.030±0.003[b]
Tridecylic acid (C13:0)	0.085±0.001[a]	0.055±0.002[b]
Myristic acid (C14:0)	10.268±0.001[a]	8.516±0.003[b]
Pentadecylic acid (C15:0)	0.963±0.001[a]	1.027±0.003[a]
Palmitic acid (C16:0)	23.954±0.015[b]	28.751±0.009[a]
Margaric acid (C17:0)	0.492±0.009[b]	0.784±0.004[a]
Stearic acid (C18:0)	9.331±0.007[b]	13.993±0.007[a]
Arachidic acid (C20:0)	0.120±0.003[b]	0.227±0.003[a]
Behenic acid (C22:0)	0.038±0.001[b]	0.087±0.001[a]
Tricosylic acid (C23:0)	0.018±0.001[b]	0.095±0.002[a]
Lignoceric acid (C24:0)	0.026±0.001[b]	0.078±0.002[a]
SFA	55.175	59.729
Myristoleic acid (C14:1)	0.937±0.000[a]	0.346±0.003[b]
Palmitoleic acid (C16:1)	1.177±0.006[a]	1.124±0.011[a]
Oleic acid (C18:1)	19.980±0.013[a]	18.584±0.213[b]
MUFA (cis)	22.094	20.055
Linoleic acid (C18:2)	1.635±0.001[a]	0.920±0.011[b]
a-Linolenic acid (C18:3)	0.661±0.001[a]	0.482±0.005[b]
Dihomo-g-linolenic acid (C20:3)	0.069±0.000[a]	0.055±0.001[b]
Eicosatrienoic acid (C20:3)	0.020±0.001[a]	0.000±0.000[b]
Arachidonic acid (C20:4)	0.105±0.000[a]	0.072±0.002[b]
Eicosapentaenoic acid (C20:5)	0.065±0.001[a]	0.056±0.001[b]
Docosahexanoic acid (C22:6)	0.032±0.003[a]	0.000±0.000[b]
PUFA (cis)	2.586	1.586
Petroselinic acid (18:1, t-6)	0.000±0.000[b]	0.171±0.006 a
Elaidic acid (18:1, t-9)	0.000±0.000[b]	0.215±0.005 a
Vaccenic acid (18:1, t-11)	2.125±0.009[a]	2.227±0.006 a
Octadecadienoic acid (18:2, c-9, t-12)	0.124±0.001[a]	0.000±0.000[b]
Octadecadienoic acid (18:2, t-9, c-12)	0.171±0.003[a]	0.000±0.000[b]
Conjugated linoleic acid (18:2, c-9, t-11)	0.995±0.000[a]	0.765±0.004[b]
Octadecatrienoic acid (18:3, t-9, t-12, t-15)	0.012±0.001[a]	0.000±0.000[b]
Octadecatrienoic acid (18:3, t-9, c-12, c-15)	0.124±0.013[a]	0.091±0.002[b]
rTFA	3.550	3.468
Total FA	83.405	84.838
n-3/n-6	0.43	0.51
AI	2.76	3.00
TI	2.62	3.00

Data are expressed as Mean±standard deviation. Different letter within a raw indicates statistically difference ($p<0.05$)

general, ghee from both sources exhibited a high lipid content composed mainly of saturated fatty acids with a low concentration of unsaturated fatty acids and a significant contribution of ruminant trans fatty acids.

DISCUSSION

The United States Department of Agriculture (USDA) has established technical specifications for the dairy product ghee. According to this standard, the chemical composition of ghee is characterized by a content of 99.6% lipids and 0.3% moisture[13]. In this study, cow and buffalo samples exhibited similar proximate compositions; nonetheless, the lipid content of both samples was lower than that reported by the USDA. After comparing the lipid content of both samples, the concentration of lipids was higher in buffalo (99%) than that in cow ghee (98.9%), which is in accordance with the fatty acid profile of each type of milk because buffalo milk has a higher lipid content[14].

The fatty acid profiles of cow and buffalo ghee exhibited similarities. Both samples showed a higher concentration of saturated fatty acids comprising 66.15% of the fatty acids contained in cow and 70.4% in buffalo ghee and a lower content of unsaturated fatty acids. Furthermore, the

cow sample displayed a 1.3-fold higher concentration of conjugated linoleic acid (CLA) than buffalo ghee due to the differences in the lipid composition of the two types of milk used.

SFAs were the main component of the two dairy products, composing 55.2 and 59.7% of cow and buffalo ghee, respectively. The results are in accordance with the content of SFAs reported in the literature. Dorni *et al.*[15] reported a concentration of 71% SFAs in ghee, Sserunjogi *et al.*[16] indicated 46% SFAs in buffalo ghee and Dwivedi *et al.*[17] described a content of 47.8% SFAs in cow ghee.

The most abundant saturated fatty acids contained in ghee samples were lauric (C12:0), myristic (C14:0), palmitic (C16:0) and stearic (C18:0) acids. Palmitic acid was the most predominant SFA, which was also reported by Dorni *et al.*[15] as the major saturated fatty acid with an average concentration of 39.1%. The same authors indicated a content of stearic and myristic acids approximately 13.9 and 11.8%, respectively. In this study, buffalo ghee exhibited the same concentration of stearic acid but showed a 1.4-fold lower content of myristic acid (Table 2). On the other hand, cow ghee exhibited fractions of stearic and myristic acids below the reported values.

The current study established a significant quantity of butyric acid (C4:0) in both types of samples: 1.7% in cow and 1.9% in buffalo ghee. These values are higher than the concentration reported by Dorni *et al.*[15] (0.22%) and Yadav and Srinivasan[18] who determined that there was no butyric acid present in ghee. According to the latter authors, the lack of this fatty acid was likely a consequence of its volatilization during the heating process in preparing ghee. Moreover, Dorni *et al.*[15] established 0.3% caproic acid (C6:0) and 0.47% caprylic acid (C8:0), which are also below the concentrations determined in cow and buffalo samples. Furthermore, the fractions of both fatty acids were higher in cow than in buffalo ghee (Table 2). Praagman *et al.*[19] asserted that the intake of higher concentrations of butyric (C4:0), caproic (C6:0) and caprylic (C8:0) acids and, in general, the intake of saturated fatty acids from dairy products, are related to a lower risk of cardiovascular disease.

Myristic, palmitic and stearic acids are saturated fatty acids that are more associated with cardiovascular disease risk. According to a study performed in Germany in 2018 to evaluate the association between erythrocyte saturated fatty acids and cardiovascular mortality (CVM), palmitic acid was identified as the SFA with the highest risk of mortality due to coronary heart disease (CHD)[20]. Moreover, the authors suggested individually evaluating the effect of each SFA and not that of the group of fatty acids. Another study carried out in the United Kingdom established that stearic and palmitic acids were the SFAs that increased the concentration of total as well as low-density cholesterol[21]. Praagman *et al.*[19] performed a study over 12 years evaluating the total SFAs and the risk of cardiovascular disease and established no association; nonetheless, the authors asserted that the intake of palmitic acid caused a higher risk. According to Ruiz-Nunez[21], cow milk exhibits a high content of short- and medium-chain SFAs, although ghee, as a dairy product of cow milk, displays a major concentration of long-chain SFAs, which is related to cardiovascular events.

On the other hand, the MUFA (cis) content was higher in cow (22%) than that in buffalo ghee (20%) and in both samples, oleic acid was the major monounsaturated fatty acid. Dorni *et al.*[15] reported a 26% MUFA (cis) concentration with oleic acid as the highest in commercial ghee samples collected in Indian supermarkets, which is in accordance with this study. The impact of this type of fatty acid on human health is difficult to estimate given the significant concentration of SFAs in most foods, especially in meat and dairy products, with the exception of some oils from plants and seeds. Nevertheless, Wang *et al.*[22] indicated that replacing the consumption of SFAs by MUFAs was associated with lower mortality.

The PUFA (cis) concentration of the two ghee samples was lower than that of the other types of fatty acids, although buffalo ghee exhibited a lower concentration (1.6%) than cow (2.6%) and linoleic acid (C18:2) was the PUFA (cis) with the highest concentration in both products and represented more than 58% of PUFAs (cis). Other studies indicated polyunsaturated fatty acid contents of 2.5[15] and 2.9%[23], which were similar to the concentration reported in this study for cow ghee. According to Doreau *et al.*[24] and Samková *et al.*[25], the composition of unsaturated fatty acids in milk and thus in ghee depends on nutritional factors such as the feed the animals forage or concentrates or supplements to the diet with lipid-rich sources.

Currently, the intake of foodstuffs containing trans fatty acids is the subject of controversy among scientists around the world; nevertheless, the recommendation from the safety perspective of human health is to reduce or even avoid its consumption, especially industrial trans fatty acids[26]. Regarding the ruminant trans fatty acids (rTFAs) of the ghee samples, the main difference between both products was the content of petroselinic (18:1 t-6) and elaidic (18:1 t-9) acids exhibited by the buffalo ghee, which were absent in the cow sample. Likewise, octadecadienoic acids (18:2 c-9 t-12) and (18:2 t-9 c-12) and octadecatrienoic acid (18:3 t-9 t-12 t-15) were found in cow ghee, while none were found in the buffalo

product. Elaidic acid is the major trans fatty acid identified in commercially prepared foods or in vegetable oils that were subjected to hydrogenation or thermal processes such as frying and according to some studies, this fatty acid is associated with insulin resistance[27]. Cow and buffalo ghee exhibited a similar concentration (2.15%) of vaccenic acid (18:1 t-11) while showing a differential content of conjugated linoleic acid (18:2 c-9 t-11) with a 1.3-fold higher concentration in cow than that in the buffalo sample. Some CLA isomers, e.g., 18:2 cis-9, trans 11, have been positively associated with health benefits due to the conjugated unsaturation that has a recognized protective effect on cardiovascular health[28]; nevertheless, such protection is not clearly defined and the scientific literature has reported inconsistent results.

Finally, Bendsen *et al.*[29] concluded that the intake of ruminant trans fatty acids (in amounts between 0.5 and 1.9 g day^{-1}) has no significant effect on the risk of coronary disease.

Kumar *et al.*[30,31] reported that ghee consumption has a hypocholesterolemic effect due to the decrease in low-density lipoprotein (LDL), total cholesterol and blood triglycerides as well as the increase in biliary excretion of cholesterol. Sharma *et al.*[32] carried out a study to evaluate the effect of ghee intake on microsomal lipid peroxidation and serum lipid levels in Fisher inbred rats to assess the risk of cardiovascular disease and other diseases induced by free radicals. The authors indicated that the intake of 10% ghee for four weeks had no effect on total cholesterol or liver microsomal lipid peroxidation, although an increase in serum triglycerides was determined.

According to Ferlay *et al.*[33], some studies have suggested that mixtures as well as isolated CLA isomers such as cis-9, trans-11 or trans-10, cis-12 have beneficial properties. The authors determined that only isolated isomers exhibited positive effects on weight loss, changes in body composition, cancer, diabetes, immunological and inflammatory functions. Moreover, animal models displayed better results than human models.

Conjugated linoleic acid is currently commercialized as a diet supplement due to its potential health benefit; notwithstanding, such supplements contain free fatty acids while natural sources comprise CLA as triglycerides. This difference might impact the bioavailability and bioactivity of CLA when consumed in commercial supplements[34].

The CLA isomer (18:2 c-9, t-11), also known as rumenic acid, has been recognized by its anti-inflammatory action in healthy people[35]. In this study, rumenic acid was a unique conjugated fatty acid contained in cow (10 mg g^{-1} total lipid mass) and buffalo ghee (8 mg g^{-1} total lipid mass). This isomer is produced mainly from the biohydrogenation of linoleic acid by the rumen bacterium *Butyrivibrio fibrisolvens*; nonetheless, the production of CLA and other intermediate compounds depends on the diet of the ruminant animals and thus, its concentration may be between 2 and 5 mg g^{-1} total lipid mass. According to the results, cow and buffalo samples exhibited at least a 1.6-fold higher concentration of CLA (18:2 c-9, t-11) than the reported content by Koba and Yanagita[28] and Ferlay *et al.*[33]

According to the nutritional recommendations of the World Health Organization, saturated and trans fatty acid intake should be limited to 10 and 1% of total calories, respectively[36]. Based on that, the consumption of 10 g of cow ghee per day (in a diet of 2000 calories) may represent an intake of 0.15% TFAs and 2.4% SFAs, which finally accounts for 15 and 24% of the daily recommendation of TFAs and SFAs, respectively.

The omega-3:omega-6 ratio (n-3/n-6) is generally used to define the index of the lipid nutritional value of foods with significant lipid contribution; nevertheless, this index is under evaluation due to theoretical and practical difficulties that have contributed to confusion[37]. Both ghee samples displayed a satisfactory n-3/n-6 ratio, although the adequate ratio fails to maintain relevance due to the low PUFA concentration of buffalo and cow ghee. A healthy diet should contain an n-3/n-6 ratio of 1:5[38]; however, cow and buffalo products showed ratios of 1:2.5 and 1:1.17, respectively. Furthermore, thrombogenic and atherogenic indices revealed that the high SFA (>50%) and low PUFA contents of both samples are a problem from a health perspective, as has been discussed for a long time by the scientific community regarding dairy products derived from milk fat[39].

Based on the above mentioned considerations, within the spreadable lipid-based foodstuffs, ghee, either from buffalo or cow, has no nutritional advantages regarding other spreadable products and its consumption will not provide high benefits for human health. Regarding the fatty acid profile, the high content of SFAs in ghee might represent technological advantages such as less oxidation and greater stability to high temperatures and thus longer shelf-life than butter[40]. Ghee might be used for cooking to enhance the aroma and flavor of the food or might be incorporated into baking products or other foodstuffs that require preparations at high temperatures[41].

Ghee might be included in the diet in moderation, considering that 10 g of ghee will provide ¼ of the total SFAs recommended for healthy nutrition. The fatty acid profile of ghee might be improved by supplementing animal feedings with sources of high contents of unsaturated fatty acids;

nonetheless, the stability of the dairy product might decrease. The authors recognize that the number of samples might be a limiting factor for establishing a strong statistical inference.

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