

Letter to the Editor

Ghee: the much maligned cooking medium, now slowly reclaiming its therapeutic reputation

Sir,

Ghee is variously a solid or liquid depending upon the ambient temperature. Ghee solidifies below 10 °C because it consists primarily of saturated fatty acids which are closely packed. The composition of ghee varies depending upon which milk animal it is derived from, but in general the chemical composition is as given in Table 1.

The fatty acid composition of cow and buffalo ghee is enumerated in Table 2.

Table 1: Chemical composition of ghee.

Chemical composition	Amounts per 100g ghee
Fats and fatty acids	
Total fat	99.5g
Saturated fat	61.9 g
Monounsaturated fat	28.7 g
Polyunsaturated fat	3.7 g
Trans fats	4.0g
Omega-3 fatty acids	1.447 mg
Omega-6 fatty acids	2.247 mg
Omega-9 fatty acids	25.026 mg
Other non-fats nutrients	
Carbohydrates	0
Minerals	0
Cholesterol	256 mg (85% DV)
Phytosterols	0
Vitamin A	3069 IU (61% DV)
Vitamin B,C,D	0
Vitamin E	2.8 mg (14% DV)
Vitamin K	8.6mg (11%DV)

It should be noted that the “smoke point” of ghee is higher than most vegetable oils, around 250 °C, making it most suitable for deep frying. Smoke point is the temperature above which the molecules of the lipid start breaking up and disintegrating. This breaking up would but necessarily be accompanied with oxidation, and the formation of peroxides and oxidation products which can harm healthy body cells and tissues.

The process of producing ghee is also varied, and has a lot of bearing on the bodily effects. This aspect is often ignored, but may prove vital where therapeutic

applications are involved. The industrial method is simply by heating cream extracted from milk by centrifugation. The traditional method is to first curdle the milk by addition of microbial cultures, extract the butter by churning the curd, and then heat this butter to get the clarified butter. A third method is to ferment the cream to get butter (cultured butter), and then heat this butter to clarify. Cream can also be churned without the addition of culture, to get industrial butter. Note here that the addition of microbial cultures changes the chemical composition of butter and consequently the ghee. Also, the Docosahexaenoic acid (DHA) content has been found to be significantly higher in ghee prepared by traditional Ayurvedic method.¹ DHA contributes to reduced risk of conditions like myocardial infarction, cancer, insulin resistance and arthritis.

Table 2: Fatty acid composition of cow and buffalo ghee.

Name of fatty acids	Carbon number	Cow Ghee (%)	Buffalo ghee (%)
Butyric acid	C _{4:0}	4.4	3.2
Caproic acid	C _{6:0}	1.5	2.1
Caprylic acid	C _{8:0}	0.8	1.2
Capric acid	C _{10:0}	1.3	2.6
Lauric acid	C _{12:0}	1.8	2.8
Myristic acid	C _{14:0}	10.8	11.9
Palmitic acid	C _{16:0}	33.1	30.6
Stearic acid	C _{18:0}	12.0	10.1
Oleic acid	C _{18:1}	27.2	27.4
Linoleic acid	C _{18:2}	1.5	1.5
Linolenic acid	C _{18:3}	0.5	0.6

There is a very interesting story in the Indian scriptures where the cardio-protective effects of cow butter are portrayed. The infant Krishna was surreptitiously sought to be poisoned by the demoness Putana who was nothing but an agent of Kansa, the king of Mathura, who was afraid that the child would grow up to slay him (as prophesized). Putana smeared her nipples with a deadly poison and suckled the infant Krishna, feigning false affection. Now, the previous night the cow-herdresses of the village had got a dream where they saw the son of Yashoda (Krishna) exhorting them to feed him fresh butter. Since Yashoda was the beloved chieftain's wife, all the cowherdresses brought freshly churned cow butter early in the morning and fed the infant boy. Ergo, when Putana suckled the infant with her poisoned teats,

Krishna's gut and blood was saturated with butter. Consequently, the infant Krishna suffered no ill-effects, rather is supposed to have tugged so furiously at the nipples of Putana, that she collapsed and died.

The use of ghee in ayurvedic preparations is legion. The life-span and immunity enhancing *Rasayans* are prepared by cooking Amla (*Embellica officianalis*) pulp in ghee and using this fried paste as a carrier for phyto-constituents of numerous herbs. For *awalehas* (thick paste) that enhance brain function also, the medium is ghee. We know that brain is primarily lipid, and it comes as no surprise that liposomal/microsomal mode of drug delivery is suitable to cross the blood-brain barrier. It is also known that lipoproteins exchange numerous apoproteins and lipid constituents among themselves during their passage through the blood, and similar exchange of lipid-soluble hydrophobic substances associated with the lipids contained within the lipoproteins would also accompany the transfer of triglycerides and cholesterol. Thus lipids as vehicles of phyto-pharmaceuticals drug delivery would be the natural choice for targeting hydrophobic, lipid soluble molecules.

One important physiological mechanism of lipid transport may be playing a huge role in the cardio-pulmonary protective effects of ghee and butter. The triglycerides (along with lipid soluble vitamins) after absorption from the gastro-intestinal tract are packaged into chylomicrons. These large lipoprotein particles are taken up by the lacteals present within the intestinal mucosal villi and folds. The lipid rich lymph from the lacteals following a meal changes colour and looks more whitish and opaque. Much of the the lymph from the small intestines drains into the thoracic duct, which ascends up the posterior abdominal wall and ultimately empties into the left Subclavian vein. Thus, the newly formed chylomicrons enter the right heart directly after their manufacture (in the GIT), by-passing the liver.² As a result, there is no metabolic change wrought by the liver and action of the lipids and lipid-soluble substances carried by these (in *rasayans* and *awalehas* like Chavanprash) can immediately be exerted upon the cardiomyocytes and innervating neurons of the electrical conduction system of the heart. From the heart, these unchanged lipids and associated molecules would then flow within seconds to the lungs, and exert action all through the lung substance via the pulmonary circulation.

The cardio-protective significance of ghee is elucidated in the *Hridayavarana* or cardiac protection process in Ayurveda. The prevalent Western scientific view of the later decades of the twentieth century, linking cholesterol to atherosclerosis and hence to cardiac disease, goes contrary to the cardio- protective precepts of Ayurveda. This apparent paradox was somewhat reconciled in the second decade of the twenty first century, when the stellar role of cholesterol in maintaining fluidity of body cells was re-emphasized, along with the finding of de-novo synthesis of cholesterol by the human body when

deprived of cholesterol. These findings were rapidly followed by the US agency FDA promptly withdrawing the strictures against cholesterol, and placing these against trans-fats.³

The ancient ayurvedic texts describe the use of ghee, honey, and antitoxic drugs to protect the heart in cases of poisoning.⁴ It is significant to note that the cardio-protective effects of intra-venous lipid emulsions is now established in cases of toxicity due to some drugs and local anaesthetic agents.⁵ The predominant theory of the heart failure prevention effects of lipid emulsions is that the emulsion creates an equilibria by expanded, intravascular lipid phase which drives the offending drug from target tissues into the newly formed 'lipid sink'. Hence, any lipophilic drug toxicity caused by overdose may possibly be reversed by lipid emulsion.⁶

Ghee has also been found to have a beneficial effect on the prevention of some types of cancers. Studies have shown that dietary cow ghee, compared with soyabean oil had a protective effect against the carcinogen induced mammary cancer in rats; it was found that decreased expressions of cyclins A and D1, Bcl-2 and PKC- α mediate the mechanism of the protective effect of ghee.⁷ Further investigations by the same workers demonstrated that cow ghee (as compared to soyabean oil) down-regulates the enzyme activities responsible for carcinogen activation in liver and upregulates carcinogen detoxification activities in liver and mammary tissues.

Thus we see the whole range of beneficial effects of ghee ranging from anti-inflammatory, anti-carcinogenic, cardio protective, anti-toxic and as lipophilic drug carriers. Further research will surely unravel even more powerful effects e.g., on gut microbiota, immunity and ageing

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Cite this article as: Bali S, Utaal MS. Ghee: the much maligned cooking medium, now slowly reclaiming its therapeutic reputation. *Int J Sci Rep* 2019;5(12):370-2.