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MINI-ARTICLE

Natural Antioxidant Use in Ghee-A Mini Review

Tanmay Hazra* and Pankaj Parmar

Dairy Chemistry Division[1], Dairy Technology Division[2], National Dairy Research Institute, Karnal (HR)-132001, India.

*Correspondence Author:

Tanmay Hazra

Email: tanmayhazra08@gmail.com

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Abstract

Ghee is an anhydrous milk fat, occupies a prominent place in the Indian diet. India produces 900,000 tonnes of marketed ghee, valued at Rs. 85,000 million. Tropical country like India a lots of ghee has been spoiled due oxidative rancidity. In general practice synthetic antioxidant has been used but due to carcinogenic effect of these synthetic antioxidant people are more concern on health and trying to concentrate on natural antioxidant. Various spice, herbs and milk ingredients have been successfully used to prevent oxidative rancidity of ghee but main problem associated with natural antioxidants are after taste effect and colour. In this review natural antioxidant in ghee is briefly discussed.

Key words: Ghee, synthetic antioxidant, natural antioxidant, accelerated storage.

Introduction

Ghee is an anhydrous milk fat, occupies a prominent place in the Indian diet. Chemically ghee is a complex lipid of mixed glycerides together with a small amount of free fatty acids, phospholipids, sterols and their esters, fat soluble vitamins (A, D, E and K), carotenoids, carbonyl compounds, hydrocarbons, charred casein, moisture and traces of trace elements like copper and iron.

Oxidative rancidity is the major pathway by which ghee undergoes deterioration. This is referred to as autoxidation because the rate of oxidation increases as the reaction proceeds under usual processing and storage conditions. Several workers have done exhaustive work to improve the stability of ghee against autoxidation through feeding specific feed to milch animals (Tandon, 1977; Hagrass *et al*., 1983), altering processing parameters (Singh *et al*., 1979), using proper packaging materials and storage conditions (Chauhan and Wadhwa, 1987; Amr, 1990a), adding synthetic antioxidants, incorporating natural antioxidants from edible plant materials, spices and condiments, aromatic herbs etc.

A favorable trend towards natural products has developed due to reports from medicinal centres regarding the potential teratogenic, carcinogenic and mutagenic effects of synthetic antioxidants in experimental animals including primates. Hence, due to increased reservations such as government regulations and toxicity of using synthetic antioxidants, the use of naturally occurring antioxidants hold good promise (Hathway, 1966). The complied literature on edible plant and milk materials used for protecting ghee against oxidative deterioration is given below:

Amla (Indian gooseberry) juice

The juice of *amla* fruit (*Emblica officinalis*) has marked antioxidant property when added at the rate of 1.25 per cent in ghee. It retards the onset of rancidity to the same extent as did 0.1 per cent propyl gallate and 0.01 per cent citric acid. The antioxidant property of *amla* juice was attributed to its high ascorbic acid and gallates content (Ahmad *et al*., 1960).

Aromatic herbs

Amr (1990b) studied the effect of addition of four aromatic herbs on oxidative stability of ghee made from Ewe's milk. Aromatic herbs namely, rosemary (*Rosmarinus officinalis*), sage (*Artemisia herballa*), fennel (*Foeniculum vulgare*) and rue (*Rutagra veatons*) were added at 7.5 per cent level to the ghee, only rosemary showed an antioxidative effect equivalent to that of BHA+ BHT (1:1, 250 ppm). All these herbs had an antioxidant effect at least for first 24 h of storage.

Shatavari

Asparagus racemosus (shatavari) root extracts have antioxidant and anti-diarrheal activities. So it is regarded as a rasayana in the Ayurvedic system of medicine. Nilakanthet (2012) reported that Ghee added with ethanolic extract (0.5%) of shatavari developed lower peroxides, free fatty acids, conjugated dienes and thiobarbituric acid value as compare to control sample of ghee during accelerated storage of 80±1^{0}C. The

oxidative stability index (OSI) of ghee added with ethanolic and aqueous extract of shatavari measured by Rancimat was found to be 16.83±0.17 h which was significantly higher than control ghee 10.33±0.17 h.

Vidarikand (Extracts)

Gandhi *et al.* (2013) evaluated antioxidative properties of Viadarikand ethanolic extract in ghee and reported that ethanolic extract of the vidarikand was more effective for preventing the development of the peroxide value and conjugated diene value in ghee during storage. Vidarikand ethanolic extract showed the higher induction period as compare to control ghee sample.

Betel, curry and drumstick leaves

Betel and curry leaves when added at 1.0 per cent level to ghee showed higher resistance to oxidative deterioration than BHA and BHT mixture. The anti-oxidative properties of betel and curry leaves were attributed to phenolic compounds, predominantly hydroxyl chavicol (Patel and Rajorhia, 1979). These leaves also contained some ascorbic acid which might work as synergist (Sethi and Aggarwal, 1956). When betel, curry and drumstick leaves were added at 1.0 and 3.0 per cent levels to ghee, which was subsequently stored for 12 m at ambient temperature, only curry leaves could protect ghee from hydrolytic rancidity and none could prevent oxidative deterioration (Thakar *et al*., 1984).

Mango seed kernel

A study was initiated by Parmar (1984) to elucidate the effect of addition of mango (*Mangifera indica*) seed kernels or its pre-extract on oxidative stability of ghee. Dried mango seed kernel powder (MSKP) added at 1.0, 1.5, 2.0 and 2.5 per cent (w/v) levels and butylated hydroxyl anisole added at 0.02 per cent level to buffaloes' milk ghee had antioxidant potentialities in the orders : 2.5 per cent MSKP >2.0 per cent MSKP >1.5 per cent MSKP >0.02 per cent BHA >1.0 per cent MSKP. The main antioxidant principles were indicated to be various types of phospholipids and the phenolic compounds of mango seed kernels. In addition to these compounds, the other possible agents were stated to be sterols, vitamin C, carotene and the interaction products of carbohydrates and protein generated during the heating process (Parmar and Sharma, 1990). Dinesh *et al.* (2000) isolated the antioxidant principles namely phenolics and phospholipids from MSKP using organic solvents. These compounds were dissolved in ghee to prepare phenolic and phospholipids extracts separately and in combination. Addition of extract in combination was more effective than individual extract. Moreover the phenolics were more effective than phospholipids in prolonging the induction period of ghee. Addition of extracts either individually or in combination at a level of 5 per cent or above were more effective in increasing the stability of ghee than addition of BHA at a 0.02 % level. It was concluded that the phenolic compounds in MSKP seemed to be the main anti-oxidative compounds which along with phospholipids gave the maximum stabilizing effect to ghee against oxidative deterioration.

Seed phospholipids

Bhatia *et al*. (1978) isolated phospholipids from sunflower seed, groundnut seed and cotton seed and added to ghee. The antioxidant potentiality of whole phospholipids from these sources was in order: sunflower >groundnut >soybean >cotton seed. This was in order of decreasing phosphatidyl ethanolamine content. Gupta *et al.* (1979) isolated lecithin and phenolic compounds from gram seeds (*Cicer arietinum*). They observed that phospholipids from this source could be good antioxidant for ghee.

Kaur *et al*. (1982) compared the seed phosphatides and synthetic compounds as antioxidants for cow and buffalo ghee. They found that antioxidant efficiency of sunflower seed oil phosphatides and synthetic compounds were in order: phosphatidyl ethanolamine>propyl gallate>palmitoylascorbate> BHA>phosphatidyl choline. The authors concluded that seed phospholipids were more effective than many synthetic antioxidants in controlling oxidative and lipolytic deterioration of ghee during storage.

Spices and condiments

Semwal *et al.* (1997) studied anti- or pro-oxygenic activity of turmeric (*Curcuma longa*) by adding its fractions (volatile oil and curcumin) in ghee at 37 ºC. The ground spice and water-soluble fraction of the spice showed antioxygenic activity. On the other hand curcumin, water-insoluble fraction, acetone soluble, ethanol soluble and insoluble fractions of turmeric showed moderate pro-oxidant activity. Volatile oil of turmeric also exhibited slight antioxygenic activity. Combination of alpha-tocopherol and curcumin showed moderate pro-oxygenic activity. Soni (2011) reported that addition of curcumin in ghee provided better storage life of ghee than control sample. He reported that addition of curcumin powder at 0.4% gave ghee higher flavor value and lower peroxide value as compare to control sample during accelerated storage and he also reported that addition of curcumin had not create any colour defect in ghee.

Tomato seed powder

Tomato seed powder added at 5.0 per cent level in ghee inhibited oxidation and ensured its stability practically to the same extent as 0.01 per cent of BHT or BHA (Guleria *et al*., 1983).

Onion skin extract

Jain (1996) elucidated the effect of addition of antioxidant principles of onion (*Allium cepa*) skin via pre-extract on the oxidative stability of ghee. The anti-oxygenic compounds of onion skin were extracted into methanol and dried. The dried material was mixed with ghee at a rate of 0.5 per cent (w/v). Addition of such extracts at different levels was found to be almost at par with addition of BHA at 0.02 per cent in protecting ghee. Quercetin and anthocyanin, the phenolic compounds appeared to be the main contributory factors in enhancing the oxidative stability of ghee.

Tulsi leaves

Sharma (1997) isolated the antioxidant principles of *Tulsi* (*Ocimum sanctum* Linn.) leaves via a pre-extraction. The anti-oxygenic compounds of *Tulsi* leaves were extracted into methanol and then vacuum dried. The dried materials were further fractionated into water insoluble fraction which was then treated with mixture of silica gel and charcoal and designated at SCF. Addition of SCF pre-extract at the level of 0.6 per cent (w/v) was found to be more effective than the addition of BHA at the level of 0.02 per cent. The phenolic compounds appeared to be the main contributory factors in enhancing the oxidative stability of ghee.

Sorghum grain powder

Kaur *et al.* (2001) studied the use of Sorghum (*Sorghum bicolor* L.) grain powder in enhancing the oxidative stability of ghee. Direct addition of Sorghum grain powder (SGP) at different levels in ghee was elevated the phospholipids as well as water extractable phenolic compounds of ghee. The results also revealed that addition of SGP at a level of 1 % (w/v) and above have higher effect than the addition of permitted level of BHA. The proactive action of SGP in ghee could be attributed to the transfer of phospholipids and phenolic compounds present in SGP.

De-husked Ragi Powder (DRP)

Mehta (2006) reported that addition of methanol pre-extract of de-husked ragi powder (DRP) at the rate of 0.1%, 0.25% and 0.5% resulted in a corresponding increase (over control) in phospholipids content and water extractable phenolics content of ghee. The anti-oxygenic indices calculated from the induction periods of ghee samples stored at 80 ± 2^0C in comparison with sample of ghee added DRP gave better result than control sample in order to prevent oxidative rancidity. This result suggested that the phospholipids and the phenolic compounds of DRP transferred to ghee enhance its oxidative stability.

Arjuna bark extract

Parmar *et al.* (2013) reported that ethanolic extract of arjuna bark increased the shelf life of ghee as compare to control sample during storage at 8^0C. Their findings also suggested that freshly prepared ghee from cow milk added with Arjuna bark had good potentiality to act as free radical scavenger.

Coriander

Patel *et al.* (2013) assessed the antioxidant activity of coriander extract in ghee and reported that coriander extract added ghee gave better oxidative stability of ghee during storage as compare to control sample but they also suggested that for ghee BHA is more effective antioxidant than coriander extract .

Ghee residue

Rama Murthy *et al.* (1969) studied the effect of addition of different concentrations of ghee residue on phospholipids free ghee. It was observed that in control samples (phospholipids free ghee without ghee residue), the peroxides appeared at an early stage of storage (2 months) than those samples with added ghee residue. For instance, the peroxide values (millimoles of peroxide per kg fat) in buffalo ghee samples at 6 months of storage were, control (8.4), ghee with 1.0 per cent ghee residue (1.6), ghee with 2.0 per cent ghee residue (1.1) and ghee with 5.0 per cent ghee residue (0.2). Santha and Narayanan (1979) reported that phospholipids, the lipid constituents of ghee residue had maximum antioxidant property followed by α-tocopherol and vitamin A. Among the non-lipid constituents, the amino acids- proline, lysine, cysteine hydrochloride and tryptophan showed antioxidant property. The addition of lactose, glucose, galactose and their interaction products with protein and phospholipids to ghee increased the oxidative stability of ghee (Pagote and Bhandari, 1988). Hence, it was concluded that the antioxidant property of ghee residue is due to its above mentioned various constituents.

Problem

In India only BHA is legally approved as an antioxidant in ghee. Though natural antioxidants have better potentiality to prevent rancidity in ghee, but no commercial trial has not been tried till date to evaluate the natural antioxidant in ghee. In another aspect during

large scale production aftertaste and flavor of natural antioxidant have not been tried till date. So, commercial application or market of functional ghee using natural product still out of reach for dairy industry.

Conclusion

Ghee has been considered immensely superior to other fats mainly because of the presence of characteristic short chain fatty acids, carrier of four fat-soluble vitamins viz., A, D, E, K and essential fatty-acids such as linolenic acid and arachidonic acid. India produces 900,000 tonnes of marketed ghee, valued at Rs. 85,000 million. The market penetration of ghee is about 37% in urban areas and about 21% in rural areas. Tropical country like Indian because of poor storage and transport facility, substantial amount ghee are spoiled due to off flavour development. Since ghee is a fat rich product, therefore antioxidants play a major role in preventing rancidity. In India synthetic antioxidant are generally used to prevent the oxidative rancidity of ghee but a favorable trend towards natural antioxidant has developed due to reports from medicinal centres regarding the potential teratogenic, carcinogenic and mutagenic effects of synthetic antioxidants in experimental animals including primates. More research needed in search of natural products that not only provide oxidative stability of ghee during storage but also provide health benefit.

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