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Efficacy of Selected Fat Constant Analysis to Ascertain the Purity of Ghee during Storage

Akash Chaudhari, Rohit Sindhav, C. H. V. K. Sudheendra, Akash Solanki, Tanmay Hazra* and Vimal Ramani

Department of Dairy Science, Kamdhenu University, Amreli, India

**Corresponding author*

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A B S T R A C T

Due to high market demand and comparatively poor supply of ghee; tends it to adulterate with cheaper oils and fats. Palm oil is one of the common adulterant widely reported in ghee. Fat constants analysis specially Richert Meissl value (R.M) value and Butyro-Refractometer **(**BR)reading regularly use to detect palm oil in ghee. However, fat constants were reported to be changed in ghee over the storage period. So present investigation was designed to check the efficacy of these two methods to ensure purity of ghee over storage period. Results of present study supported that BR reading and R. M value analysis able to detect palm oil in ghee when fresh or without storage. Although during storage both BR reading and R.M value decrease and increase respectively, for both pure and adulterated ghee. Hence, both this techniques are not sufficient alone to ascertain the purity of ghee during storage.

Introduction

Ghee or clarified milk fat, has an integral relation with Indian culinary and social culture. Basically it is prepared by clarification of milk fat (cream or butter) at a temperature of 110^{o}C to 120^{o}C (Jariwala, 2014). It occupies a special position among all edible fats and oils; due to its better digestibility and therapeutic properties (Ramani *et al.*, 2019). It is one of the best source for many bioactive components including essential fatty acids, fat-soluble vitamins viz., A, D, E, K etc (Hazra *et al.*, 2017). The digestibility and absorption of ghee is better than others fats and oil due to presence of short and medium chain fatty acids (Ramani *et al.*, 2019).

Adulteration in foods for more profit, is a big curse for modern human society. Superior quality of oils and fats always a key target of

adulteration; therefore, trends to mix with cheaper quality of oil or fats for more profit (Quinones-Islas *et al.,* 2013; Lumaksoa *et al.,* 2015). The market price of pure ghee is normally 2 to 3 times higher than the commonly available edible oils and fats. Due to high market demand and poor or less supply of ghee; trends it to adulterate with cheaper oils and fats with ghee (Nurrulhidayah *et al.,* 2013). The most common types of adulteration usually reported in ghee are vegetable oils (such as palm oil), fat obtained by hydrogenation of vegetable oils and animal body fats etc. Fatty acids make up of some adulterants like palm oil, has very close resemblance to ghee; therefore, it is very tough to detect foreign fat in ghee by simple physico-chemical analysis technique (R.M and BR) (Pathania *et al.,* 2020). Recent scientific studies suggested that due to close resemblance of fatty acids make up between ghee and palm oil; unscrupulous traders use to admix palm oil with ghee (Ramani *et al.,* 2019). Fat constants analysis based methods are successfully used to detect palm oil in ghee (Ramani *et al.,* 2019; Hazra *et al.,* 2017). However, these two fat constants were reported to be changed in ghee over the storage period (Bharti *et al.,* 2020). However, no scientific studies ever reported, efficacy these two methods for detection of vegetable oil in ghee during storage. Therefore, a systemic study was conducted to ascertain the purity of ghee basedR.M and BR analysis over storage.

Materials and Methods

Procurement of milk and preparation of ghee

Mix milk, was used for the preparation of ghee samplesand were collected from the Amrelidistrict's local dairy farmers. Samples of ghee was be prepared by creamery butter method (De, 2005).

Procurement of milk oil

Palm oil was used as adulterant in the present investigation. Various brands of Palm oil were purchased from local market of Amreli.

Preparation of adulterated ghee samples

For the preparation of adulterated ghee samples, pure ghee samples was heated to 60-70°C for 10 min before adding and mixing of adulterants in ghee @ 5%, 10% and 20%, respectively. The ghee samples were stored at 80°C (accelerated storage) up to 15 days.

Parameters Studied

The ghee samples were analyzed intervals of 2 days for Reichert-Meissl(RM) Values, BR, Peroxide Value (Millimoles/gm of sample) as per the procedure described in FSSAI (2017) at ambient temperature.

Statistical analysis

Data have been expressed as mean values. In experiments, wherever required, analysis of variance (ANOVA) with a subsequent completely randomized design (CRD) and critical difference test at 5% level of significance ($P< 0.05$) to compare the different treatments means. ANOVA carried out by SPSS and OPSTAT software.

Results and Discussion

Effect of storage of physico-chemical properties of pure ghee and adulterated

Effect of storage on Butyro-Refractometer (BR) reading of pure ghee and adulterated ghee

BR reading measures the index of refraction between air and the liquid fat, and vary with the nature of the fat; it is usually determined at

40°C. It is an important parameter to ascertain the quality of ghee. The effect of storage (80°C) on BR reading of ghee as well as palm oil adulterated ghee is depicted in Figure 1. It was observed that for pure ghee, BR reading was 41.80 which was decreased throughout the storage period however, up to seven days of storage no significant ($p>0.05$) change was observed. Although after 7th days up to 15th days the significant ($p\leq0.05$) decreased in BR reading was observed for pure ghee.

It was also observed that as compared to pure ghee for 10% adulterated ghee, the BR reading was increased significantly ($p\leq0.05$) although no significant ($p>0.05$) difference was observed during adulteration of ghee with palm oil @ 5%, at zero day of storage. Based on observation it could be concluded that based on B.R analysis 10% palm oil could be detected when ghee is fresh. It was also observed that throughout whole storage period for both pure and adulterated ghee the B.R reading decreased. From the present study it could be explained that during storage unsaturated fatty acids get oxidized, so the BR reading used to be decreased. Though there was decrease in BR reading during the entire storage period the values of adulterated and pure samples were well within the standard specified in (FSSAI, 2017).

Present results supports earlier observation of Gosewade *et al.,* (2016) who reported to decrease the BR reading during storage. From the present findings it can be concluded that analysis of BR reading could not specifically ascertain the presence of vegetable oil in ghee during storage.

Effect of storage on Reichert-Meissl (R.M) valueof pure ghee and adulterated

It is very important fat constant to ascertain the purity of certain fats. R.M value generally measure water soluble steam volatile fatty acids like Butyric acid. R.M value of ghee ranges from (21-28) FSSAI (2020).

The observation for the change of RM value of pure and adulterated ghee stored at 80°C is given in Figure 2. During zero day of storage a significant ($p<0.05$) difference was observed between pure and even 5% level of adulterated ghee.

It was also observed that during whole storage period both the cases R.M value increased. At zero day, R.M value for pure ghee was 29.10 which significantly higher ($P<0.05$) than adulterated ghee. But advancement of storage period, the R.M value for both pure and adulterated ghee were increased.

It can be concluded that during storage unsaturated fatty acids got oxidized so decreased and percentage of short chain fatty acids used to be increased.

Therefore, R.M value apparently increased. So based on R.M value analysis it is very tough to ascertain the purity of ghee over storage.

Effect of storage on peroxide value of pure ghee and adulterated ghee storage at 80°C

Peroxide value is defined as the milliequivalents of peroxide per kilograms of fat. It primarily determines oxidative rancidity of specified fats and oil. Figure 3, represents the change in Peroxide value of pure and adulterated ghee stored at 80°C.

A significant increase ($p\leq0.05$) was observed in Peroxide values of ghee and adulterated ghee during storage. Peroxide value of pure ghee increased significantly ($p\leq0.05$) from 0.52 on zero day to 3.92 on fifteen day of storage whereas for adulterated ghee with palm oil (@5%, @10%, @20%) (Table 1).

Table.1 Storage of sample

Sample	Storage	
	Temperature	**Time**
Pure ghee	Room Temperature and 80°C	80°C - 15 days storage
Pure ghee +5 % Adulterant		
Pure ghee + 10 % Adulterant		
Pure ghee + 20% Adulterant		

Fig.1 Butyro-Refractometer reading of pure ghee and adulterated ghee store at 80°C

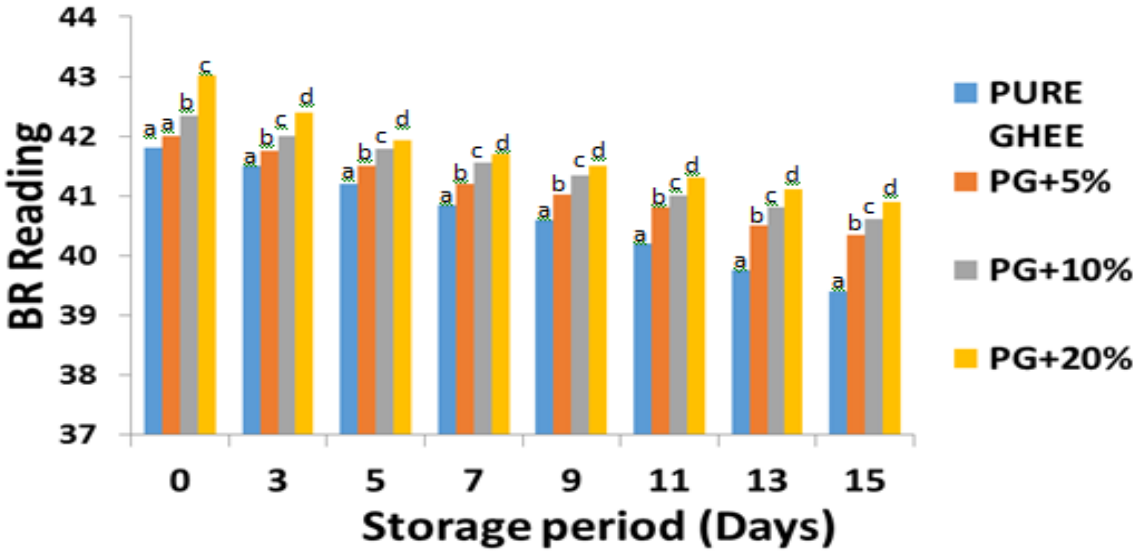


Fig.2 Reichert-Meissl (RM) value of pure ghee and adulterated ghee store at 80°C

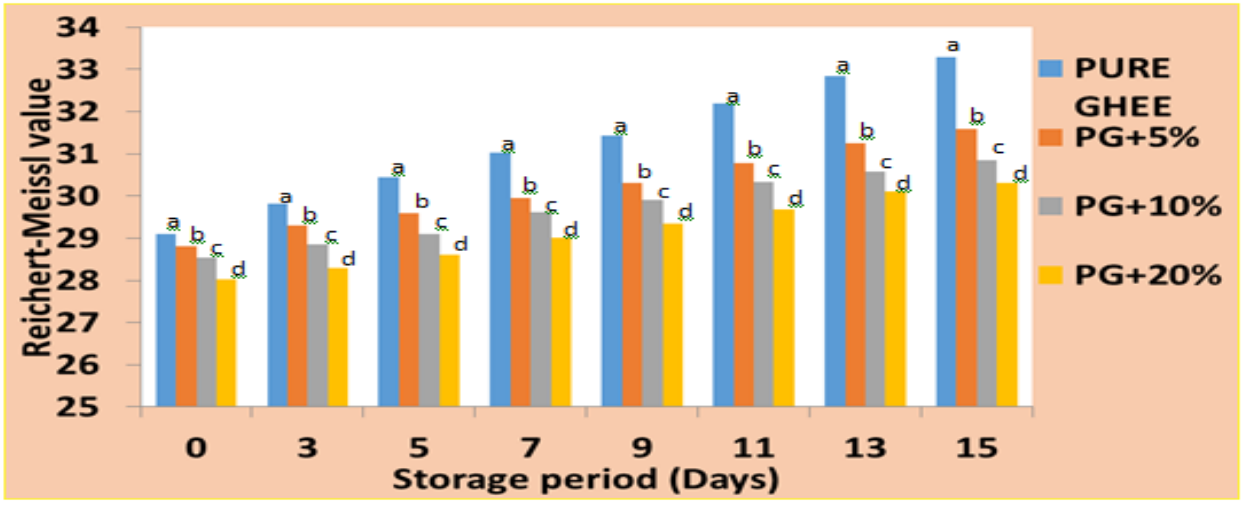
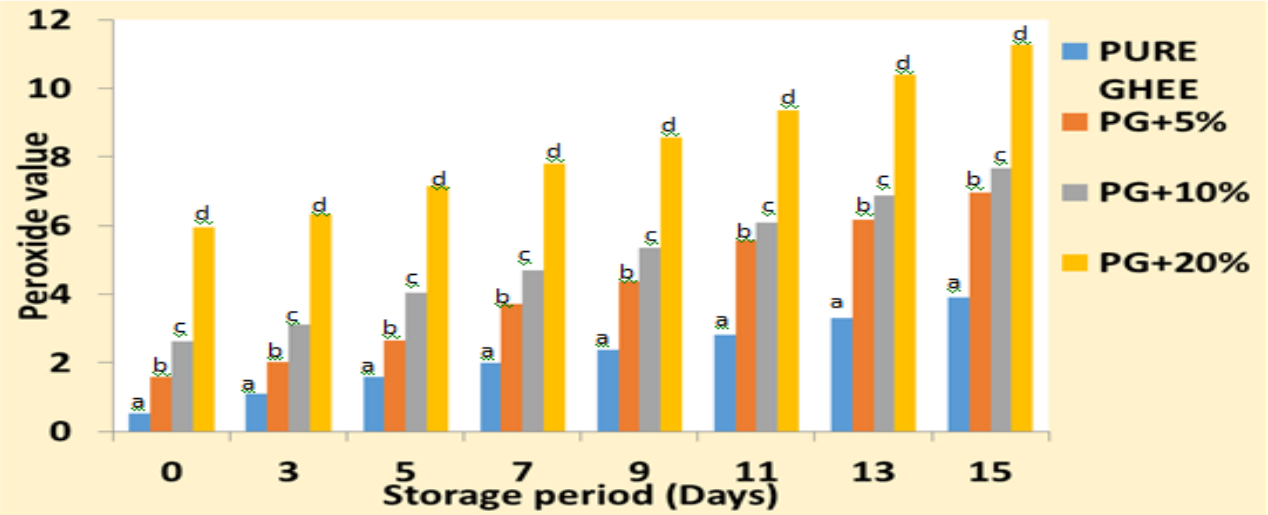


Fig.3 Peroxide value (expressed as milliequivalent oxygen per kg of fat) of pure ghee and adulterated ghee store at 80°C



After the end of storage highest Peroxide value was observed for ghee (11.26) adulterated with palm oil at 20%. Findings of the present investigation are in accordance with the findings of Gosewade *et al.*, (2016). They reported that to increase in Peroxide value from 0.00 to 2.59 in cow ghee and from 0.00 to 3.19 in buffalo ghee on the tenth day of storage at 80°C.

For fresh ghee without oxidation both R.M value analysis and BR reading able to detect adulteration of ghee @5 and 10% respectively. However, during storage both these constants changed for both pure and adulterated ghee. Hence after storage (80C for 15 days) both pure and adulterated ghee falls under the range suggested by FSSAI. But during storage peroxide value increased. Hence, based on fat constant analysis it is very tough to ascertain the quality of ghee over storage.

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