



Characteristics of Ghee Residue and Utilization in Value-Added Products

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Ghee residue is a byproduct obtained during ghee production. It is a nutrient-rich dairy byproduct containing good amounts of protein, fat, and phospholipids. It has potential functional benefits. Due to a lack of awareness about its extensive nutritional properties and the absence of effective utilization methods, it is drained away as waste by most dairy industries. Despite containing many nutrients, it is still underutilized. Thus, the effective utilization of ghee residue can increase the economic efficiency of the dairy industry by adding value to this byproduct.

Ghee residue is a burnt, dark brown residue that accumulates on the cloth after ghee is filtered. During ghee production, the fat present in cream or butter gets concentrated as ghee, and other components settle down as a solid mass known as ghee residue. The quantity of ghee residue varies with the method of ghee preparation. This is due to changes in the non-fat serum components of the various ingredients used to prepare ghee. The Direct Creamery method yields the highest average quantity of ghee residue (12 percent). This is followed by the Creamery Butter and Desi Butter methods, which yield about 3.7 percent. Ghee residue, especially that obtained from creamery butter, contains a high amount of phospholipids, accounting for 17.39 percent of the total fat. The high phospholipid content (a good emulsifier) in ghee residue is beneficial in developing products where the emulsification of fat and aqueous phases is desired. The shelf life of all types of ghee residue clarified at 120°C is 3 months. Its shelf life can be extended to over 4 months by pressing it into cake form.

After liquid milk, ghee is the second most widely produced and consumed dairy product. A large quantity of ghee residue is collected from its production. The dairy industry byproduct obtained from ghee production, ghee residue, has high nutritional value. It is a nutritious byproduct of milk containing good amounts of protein (18–42 percent), fat (33–65 percent), and phospholipids (3.6–17.39 percent). Furthermore, flavoring compounds such as free fatty acids and carbonyls are 10 times higher, while carbonyls in ghee residue are 100 times higher compared to ghee. Although high in nutrients, it is still underutilized; effective recovery of ghee residue can increase the plant economy by adding value to this byproduct and, in turn, reducing the environmental impact of dairy products. It is currently used as animal feed, as manure, and to some extent in the bakery industry.

Physico-chemical and Functional Properties of Ghee Residue

Ghee residue can be considered a good source of natural antioxidants, and its antioxidant properties are influenced by various technical parameters because of its components. Ghee residue has been found to consist of several nutrients such as proteins, fats, carbohydrates, and minerals, mostly calcium and phosphorus. Due to this nutritional value, it is used as a dietary supplement for human food ingredients as well as animal feed. Several studies have been conducted regarding its use in food products. Depending on the intensity of heat treatment used during ghee production, the color of ghee residue can range from light to dark

brown. It has a smooth to granular texture with a glossy exterior due to the presence of additional free fat. The average particle diameter of ghee residue is about 105 microns, and its average density is 1.14 g/cm³.

Chemical Composition

The use of ghee residue in vegetarian food serves as an alternative to animal protein, with a value of 2.55 compared to casein at 2.62. Its nutritional value can be enhanced to equal or slightly higher levels than skim milk powder, containing 8 percent lysine, 1.4 percent tryptophan, and 2.5 percent methionine. When ghee residue and skim milk were blended in ratios of 2:1 and 1:2, the protein efficiency ratio was increased to 3.07 and 2.46, respectively. Additionally, when a protein supplement of 0.5 percent lysine was used for ghee residue, an increase from 0.66 to 2.46 was observed. The nutritional value can also increase when supplemented with amino acids such as 2.5 percent methionine, 8 percent leucine, and 1.4 percent tryptophan.

There is considerable variation in the chemical composition of ghee residue depending on the ghee production method. Studies indicate that ghee residue contains 17.98 to 29.80 percent protein, 45.21 to 61.03 percent fat, 7.49 to 9.53 percent lactose, and 1.70 to 6.58 percent minerals. The phospholipid content and antioxidant activity (% free radical scavenging activity) of ghee residue samples varied from 3.18 to 15.09 percent and 27.04 to 67.80 percent, respectively.

Functional Components of Ghee Residue

Functional components are those responsible for health benefits in addition to the nutritional value of food. Ghee residue contains antioxidants such as free fatty acids, PUFA, sulfhydryls and free sugars from lactose. Antioxidants help extend shelf life, maintain the nutritional quality of lipid-rich foods, and modify the consequences of oxidative damage in the human body, possessing both lipid and non-lipid antioxidative properties. The lipid antioxidants present in ghee residue are phospholipids and phospholipids (Vitamin A). Non-lipids include amino acids, proline, lysine, cysteine hydrochloride, and tryptophan.

Conclusion

In conclusion, ghee residue represents an exceptionally rich yet largely underutilized source of proteins, healthy fats, antioxidants, and functional emulsifiers. Rather than discarding this byproduct as industrial waste, adopting efficient recovery techniques can significantly improve the sustainability and economic viability of dairy processing plants. By leveraging its unique nutritional profile, excellent flavour compound concentrations, and functional properties, ghee residue holds immense potential for formulation into diverse, high-value functional foods, bakery items, and dietary supplements.