



Characterization of traditional Egyptian Samna and comparison with processed anhydrous milk fat: A comprehensive analysis of volatile components and physiochemical properties

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ABSTRACT

Historically, Samna is a clarified fermented Egyptian butter that has a vital role in the human diet, primarily due to its nutritive value and pleasant flavor. Herein, we performed an in-depth screening to evaluate the volatile and physiochemical properties of different traditional Egyptian Samna compared with processed anhydrous milk fat by analyzing their fatty acids composition, volatile components, melting, and crystallization behavior using GC, GC–MS–O, and DSC approaches. Saturated fatty acids were significantly abundant (67.18%–69.53%) compared to unsaturated fatty acids (26.11%–30.30%) in all samples. Overall, 38 different volatile compounds were quantified. Remarkably, higher concentrations and odor activity values (OAVs) of carboxylic acids were observed in traditional Samna and anhydrous milk fat from Egyptian cow milk compared to Chinese anhydrous milk fat. Additionally, furan and alcohol compounds were exclusively detected in traditional Samna from cow and buffalo sources, a distinction from Chinese anhydrous milk fat. Olfactory analysis coupled with GC–MS identified 36 odor-active compounds. Network analysis investigated the relationships between these potential aroma compounds associated with key sensory attributes; especially, 2-nonanone, 2,3-butanediol, δ -decalactone, n-hexadecanoic acid, and ethyl octanoate were linked to cheesy aroma notes. Principal component analysis and heat map results effectively categorized all the samples into four groups based on their distinct odor characteristics.

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1. Introduction

Good flavor in dairy products is one of essential quality marks. Samna is a traditional fat-rich dairy product known as heat clarified butter or anhydrous milk fat. Concurrently, there is a rising inclination among consumers towards locally sourced conventional dairy commodities due to the unique, rich flavor they offer for use in cooking, sauce toppings, baking, and frying foods (Sserunjogi, Abrahamsen, & Narvhus, 1998). This product has been significantly impacts in the Egyptian diet and is recognized globally under various names such as “Samna” in Egypt, anhydrous milk fat (AMF) in China, “ghee” in India, “Sadaya” in Turkey, “butter oil” in Brazil and “maslee” in Iran (Findik & Andic, 2017; Karakus, Akgul, Korkmaz, & Atasoy, 2022). Chemically, Samna is a lipophilic product with complex mixture of glycerides, phospholipids, rich content free fatty acids, carbonyls, vitamins, sterols, minor amounts of burnt caseins and lower quantities of minerals (Karakus et al., 2022; Mehta, 2009).

There are different basic methods for Samna processing are indigenous (desi) or traditional method, creamery-butter, direct-cream, pre-stratification, and continuous method (Aneja, Mathur, Chandan, & Banerjee, 2002). In Egypt, Samna is traditionally prepared at home from cow and buffalo milk fat by spontaneous fermentation of creamery-butter without any standardization by applying one of the main steps is a heat treatment at temperature ranging from 110 °C to 120 °C for 10 to 15 min until the water is completely removed and solid not fat color changes to browning. The Samna is then screened, and upon cooling to 55 °C, filtration is performed to remove Samna residue and obtain clarified Samna (Battula, Laxmana Naik, Sharma, & Mann, 2020; Benkerroum & Tamime, 2004). Meanwhile, Chinese anhydrous milk fat (AMF) is made from the direct cream and creamery-butter process by the modern dairies. Samna distinguishes itself from other fatty products, such as butter oil and anhydrous fat, through its preparation methods and unique flavor profile (Aneja et al., 2002). Microbial fermentation (Lipolysis), Maillard's reaction and caramelization are the main pathways for high-quality flavor development in Samna compared to industrial AMF for generating these key flavor compounds (Duhan, Sahu, & Naik, 2020). Ghee is an interesting case as

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