

# Acceptance of a Protein Fortified Biscuit Recipe for Use among Geriatric, Nutritionally Compromised Patients

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## Abstract

Malnutrition is prevalent in the geriatric population, as is age-related decline in skeletal muscle mass. Research indicates that nearly forty percent of older adults in skilled nursing facilities across the nation are undernourished, with over half experiencing protein-energy malnutrition (PEM). Effects include a gradual loss of mass, strength and function. Concurrently, studies indicate optimal protein-energy intake increases the quality and length of life, and mortality may be reduced by supplementation in this group. However, as protein needs increase, skilled nursing facilities struggle to meet patient protein needs as appetite, amino acid metabolism, chewing, and swallowing capacity decline. Nutrient-dense foods are essential in promoting geriatric health with an emphasis on protein. Fortification of foods is a common, cost-effective approach to enhance nutritional health in this setting, as increasing the volume of food intake is not always a viable solution. The aim of this research was to create a functional food, fortifying a food item that is eaten as a part of a typical diet. Researchers modified a biscuit recipe to increase the protein and calorie content of this popular southern food and compared the acceptance among a sample of adults (n=97) during a blind trial, and the effects of adding two different protein powders, a whey protein modular or instant dry milk powder, on nutrient composition. Analysis of Variance and post hoc testing indicated a statistically significant effect when adding protein sources on acceptability, texture, and flavor ( $P < 0.05$ ). Participants rated the flavor and overall acceptance of the milk fortified protein biscuit highest among variations, with the texture of the control and milk variations most similar; the whey variation was poorly accepted. Results suggest the addition of instant dry milk powder to a popular biscuit recipe may be a cost-effective method of improving its nutrient composition, while maintaining acceptability.

**Keywords:** Protein; Geriatric; Malnutrition; Fortified; Foods; Healthcare

## Background

Malnutrition, in the geriatric population, particularly in long-term care and skilled nursing settings, is of concern as it is widespread and poor clinical outcomes are often the result [1-3]. Crogan and Pasvogel [4] found that more specifically, incidence of protein-calorie malnutrition (PEM) among adults in the nation's nursing homes is as much as 85%. Changes in body composition account for variation in energy needs in older adults, as lean body mass declines 25% from 50% of total body mass in early adulthood, to ages 75-80 years [3]. We know that a diet with adequate carbohydrates as well as protein foods can assist in sparing amino acids [5], however declines in appetite often result in the use of body proteins to ensure physiologic functions. In aging individuals, protein deficiency is further complicated by declining chewing and swallowing capabilities, which may affect intake of animal protein foods. Simultaneously protein needs increase to greater than the 0.8 grams recommended for the general adult population to prevent muscle depletion [3,6]. Replacing deficits and enhancing protein stores to improve body composition and lean body mass, can improve quality of life, including abilities to perform every day activities, such as self-care and eating [1,4].

Modular protein supplements are commonly used in the long-term care and skilled nursing setting, and a variety of products are widely available, including those derived from milk and soy [7]. Protein modulars, including whey protein powders, are readily available through healthcare supplement companies. However, these can be cost prohibitive, and acceptance variable. Dried milk powder, an alternative available at most grocery stores at minimal cost, is also popular in its use. Milk and whey products have been shown to be superior in digestibility compared with soy [6]. Further, leucine, an essential amino acid crucial in the process of muscle protein synthesis, is present in high

concentrations in cow's milk and milk powders [8]. Whey products, in particular those fortified with leucine, are effective as well at maintain muscle mass [6]. In the healthcare setting, particularly long-term care and skilled nursing facilities, protein and calorie fortified versions of popular foods like soup, potatoes, oatmeal, and breads have shown some success in promoting adequate calories and protein intake in the elderly population [9,10]. With this in mind, the aim of this study was to increase the protein and calorie content of a typical biscuit, a popular Southern food, and determine the effects of adding two different protein sources, a whey protein modular or instant dry milk powder, on nutrient composition and sensory acceptance among adults.

## Methodology

Approval was obtained from ETSU's institutional review board. A typical biscuit recipe (C), and two variations with added protein modulars (whey protein: V1) and (milk powder: V2) were prepared. Similar grams of protein were added to each variation, with estimated protein content for each biscuit: (C) 3 gm; (V1) 7.5 gm; (V2) 6 gm.

Subjective analysis of the samples was completed by an untrained panel of adults. Subjects (N=97) were given three blind-labeled samples

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for sensory analysis utilizing a 5-point Likert scale for appearance, texture, flavor, and overall acceptability. Mean scores were calculated for all subjective results. Utilizing the Statistical Package for the Social Sciences (SPSS) software version 22, Analysis of Variance (ANOVA) was utilized to determine the effect of adding protein sources on acceptability, texture, and flavor ( $P < 0.05$ ).

Proximate analysis was conducted to determine the nutrient composition of each variation. Samples of variations were frozen to  $-30^{\circ}\text{C}$ , then further freeze dried, ground, and dry matter (DM) subjected to Kjeldahl digestion, Soxhlet extraction and bomb calorimetry standard techniques to determine macronutrient content and caloric density.

## Results

### Sensory results

Participants rated the flavor and overall acceptance of the milk fortified protein biscuit highest among variations, with the texture of the control and milk variations most similar (Table 1 and Figure 1). The whey fortified protein variation had significantly lower results across all sensory characteristics, with the exception of appearance. Only the appearance of the milk fortified protein variation was lower than the control. Analysis of Variance indicated a statistically significant effect when adding protein sources on acceptability, texture, and flavor ( $P < 0.05$ ). Post-hoc testing (Tukey HSD) determined that while the milk powder fortified variation was similar to the control across sensory characteristics including overall acceptance, the whey protein fortified biscuits rated significantly worse in acceptance, flavor, and texture. Proximate analysis of biscuits demonstrated similar kilocalorie per gram of DM (4.67 (C), 4.81 (V1), 4.70 (V2)), ether extract, or percent fat (% of DM) (35.6 (C), 33.3 (V1), 33.4 (V2)), crude protein (% of DM) (12.4 (C), 18.0 (V1), 16.7 (V2)) and inorganic content (% of DM) (5.2 (C), 4.2 (V1), 5.6 (V2)). All analyses were run in duplicate with minimum 95% agreement between duplicate samples.

### Discussion

Researchers were pleasantly surprised at the sensory outcomes. Results showed the milk-powder fortified biscuit variation had

increased acceptance across flavor, texture and overall acceptance when compared to both the control and whey protein variations, suggesting the addition of dry milk powder to a popular biscuit recipe may be a cost-effective method of improving the nutrient composition, while maintaining acceptability.

This versatile fortified biscuit could be utilized in a number of savory and sweet applications, and offers a great option for nutritionally compromised populations, such as geriatric adults in long-term care and skilled nursing facilities, providing an acceptable means for increasing protein intake with and already popular southern food. Results indicated that utilizing whey protein powder in this application would not be a feasible approach due to cost and poor acceptance of the end product.

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	Control	Nonfat Milk Powder	Whey Protein
Texture	5.15	5.15	4.49
Flavor	4.16	5.34	4.31
Appearance	5.49	5.32	5.58
Overall Acceptability	5.19	5.37	4.70

Table 1: Mean scores- sensory characteristics.

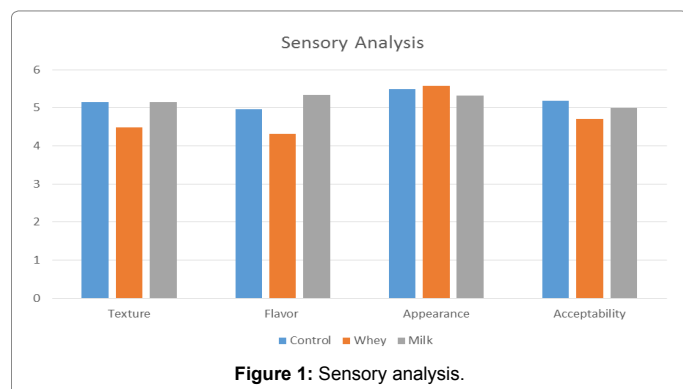


Figure 1: Sensory analysis.