

Consumer Acceptability and Physico-chemical Composition of Coconut Spreadable Cheese Substitute

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ABSTRACT— *The aim of this study was to develop a coconut milk-based cheese spread and determine its acceptability among young, adult and elderly consumers as well as to determine its physico-chemical composition. The sensory characteristics and physico-chemical composition of the coconut spreadable cheese substitute (CSCS) was evaluated and compared to a commercial cheese spread. Consumer acceptability of CSCS by the said consumers were proven to be significantly different ($P < 0.05$) in all attributes, wherein the CSCS was favoured more than the commercial cheese spread by both the adult and elderly consumers. In addition, the flavour of the CSCS was described by these groups of panellists as having a smoother texture and a less salty taste. Among the three groups of consumers, the elderly consumers highly preferred the CSCS than young and adult consumers. In terms of its physico-chemical composition, there are significant differences between the two cheese spreads except for pH. The difference between the chemical composition of CSCS and commercial cheese spread reflected the differences between its formulations. Overall, the use of coconut milk in making cheese substitute is feasible and is highly acceptable to the groups of consumers.*

Keyword(s)—coconut milk, spreadable cheese substitute and consumer acceptability

1. INTRODUCTION

Processed cheese represents an extremely delicate and complex system as its properties are affected by many variables, such as the composition and nature of the cheeses used as ingredients, type and amount of melting salts, pH and processing parameters [10]. Therefore, it is indispensable to study the influence of using new ingredients in the processed cheese's quality.

Cheese substitutes or analogues or imitation cheeses may be generally defined as products that are intended to partly or wholly substitute for or imitate cheese and in which milk fat, milk protein or both are partially or wholly replaced by non-milk-based alternatives, principally of vegetable origin [7]. Contrary to the present status of processed cheese, the initial idea of processed cheese was to increase shelf life of natural cheese and alternative uses for natural cheese that was difficult to sell. Cheese analogues are being used increasingly due to their cost effectiveness, attributable to the simplicity of their manufacture and the replacement of selected milk ingredients by cheaper vegetable products [23], so as the potential to overcome problems associated with natural cheeses such as high production and storage costs, functional variability and compositional and nutritional inflexibility [13]. Thus, the use of coconut milk as the primary ingredient of a cheese spread instead of the usual animal's milk offers an evolution to the traditional cheese spreads.

Coconut milk is a white thick liquid extracted with water from freshly grated coconut kernel. It is an emulsion containing fat, protein, sugars, minerals and vitamins [19]. Unlike cow's milk, coconut milk is lactose-free and can be a good alternative for people pursuing a lactose-free diet [25]. It also contains carbohydrates (mainly sucrose and some starch), lipid and minerals like P, Ca and K [9].

Hence, this study was conducted with the following objectives: (1) to determine the consumer acceptability of CSCS among young, adults and elderly consumers, (2) to compare the sensory acceptability of CSCS product to the existing commercial spreadable cheese and (3) to determine and compare the physico-chemical composition of CSCS with the commercial cheese spread.

2. MATERIALS AND METHODS

2.1 Preparation of Coconut Spreadable Cheese Substitute

The CSCS was prepared by combining the two mixtures: mixture A (starch, carrageenan, salt, sugar, CMC (carboxymethyl) powder, cheese powder and distilled water) and mixture B (coconut milk, cheese flavor, carbonated water, nutritional yeast and diced pimiento). The measured ingredients were placed in order of liquids and dry ingredients. Both mixtures were combined and cooked at 60°C for 15 minutes. Continuous stirring was performed to achieve the desired consistency of the CSCS [22].

2.2 Sensory Evaluation with Consumer Panel

Consumer acceptability was performed to determine the general acceptability of the CSCS by young, adult and elderly consumers. Stone and Sidel (1993) recommended using between 25 and 50 consumers for laboratory studies. Elderly consumers of cheese spread, ages 60 years and above were randomly selected from different locations in different provinces of the Philippines, whereas adult consumers, ages 19 to 59 years old, were randomly selected inside the premises of the University of Santo Tomas. Young consumers, ages 18 years old and below, were also chosen by random in the University of Santo Tomas, most of them students of the said university itself. General acceptability was determined based on a Hedonic scale of 1 to 9. CSCS was analysed by the consumers along with a commercial cheese spread in order to determine its consumer acceptability.

2.3 Physico-chemical Analyses

Coconut spreadable cheese substitute were examined for pH, (Jenway 350 @ 20°C), titratable acidity and free fatty acids were acquired by Nielsen (2010). The viscosity (Brookfield viscometer @ 21°C and 20rpm) and water activity (enBSK Sensor @ 25°C) were also measured. The fat content was determined through the acid hydrolysis method, protein (Kjeldhal method), moisture (oven air-drying method) and ash (muffle furnace method) were analysed following AOAC procedures [1]. Carbohydrates were calculated by difference [1].

2.4 Statistical Analysis

T-test was used to determine the difference between CSCS and the commercial cheese spread. One way Analysis of variance was used to compare acceptability of CSCS among the consumers. Significance differences was represented as $P > 0.05$. T-test was also used for statistical treatment of physico-chemical composition between CSCS and the commercial cheese spread. Triplicate readings were done per method of analysis and the standard error mean (SEM) was performed.

3. RESULTS AND DISCUSSION

3.1 Sensory Preference of CSCS over Commercial Cheese Spread

The acceptability of commercial cheese spread and coconut spreadable cheese substitute were evaluated by 150 panellists from different age groups, namely young consumers (ages 18 and below), adult consumers (ages 19 – 59) and elderly consumers (ages 60 and above). Consumers choice responses on sensory difference of CSCS and the commercial cheese spread, showed significant variability in all attributes ($P > 0.05$).

Young consumers preferred the CSCS more than the commercial cheese spread (Figure 1) in terms of its color, spreadability and texture. However, in terms of its appearance, aroma, flavour and general acceptability, the commercial sample is more preferred than the CSCS. They prefer the salty taste of the commercial spread rather than the CSCS. Younger people often have a limited range of experience (and perhaps a limited range of food appreciation); they may be more likely to prefer foods for their hedonic qualities. Indeed, young people have been found to prefer saltiness and intense sweetness more than adults [24].

Nonetheless, adult and elderly consumers favoured the CSCS more than the commercial cheese spread in terms of all attributes (Figure 1).

Consumers open ended comments on appearance, aroma, taste, flavour, texture, and general acceptability were widely varied. For example, during sensory acceptability testing, most of the young consumers stated that the CSCS is less salty than commercial cheese spread. This consumer also noticed a minimal coconut aftertaste and aroma in the CSCS.

Adult and elderly consumers remarked that they prefer the CSCS over the commercial cheese spread because of its less salty flavour, less creamy and the smoother texture. Their remarks can be contributed to the ability to detect and discriminate between tastes differences as one ages [2]. The sweet aroma of the CSCS also contributed to its favourable acceptability compared to the commercial cheese spread. Consumers have higher threshold of smell sensitivity with age, suggesting that odor identification seems to be less efficient and that odors need to be stronger and more intense to be perceived and differentiated by older adults [17]. The aroma of the CSCS is strong, though the ability of elderly

consumers to smell tend to diminish overtime, they were able to detect the strong cheese aroma of the CSCS. Furthermore they stated that coconut after taste and aroma of the CSCS were not detected. In terms of spreadability and texture, the elderly consumers preferred CSCS over the commercial cheese spread because according to them, it has a softer and smoother mouthfeel and spreadability.

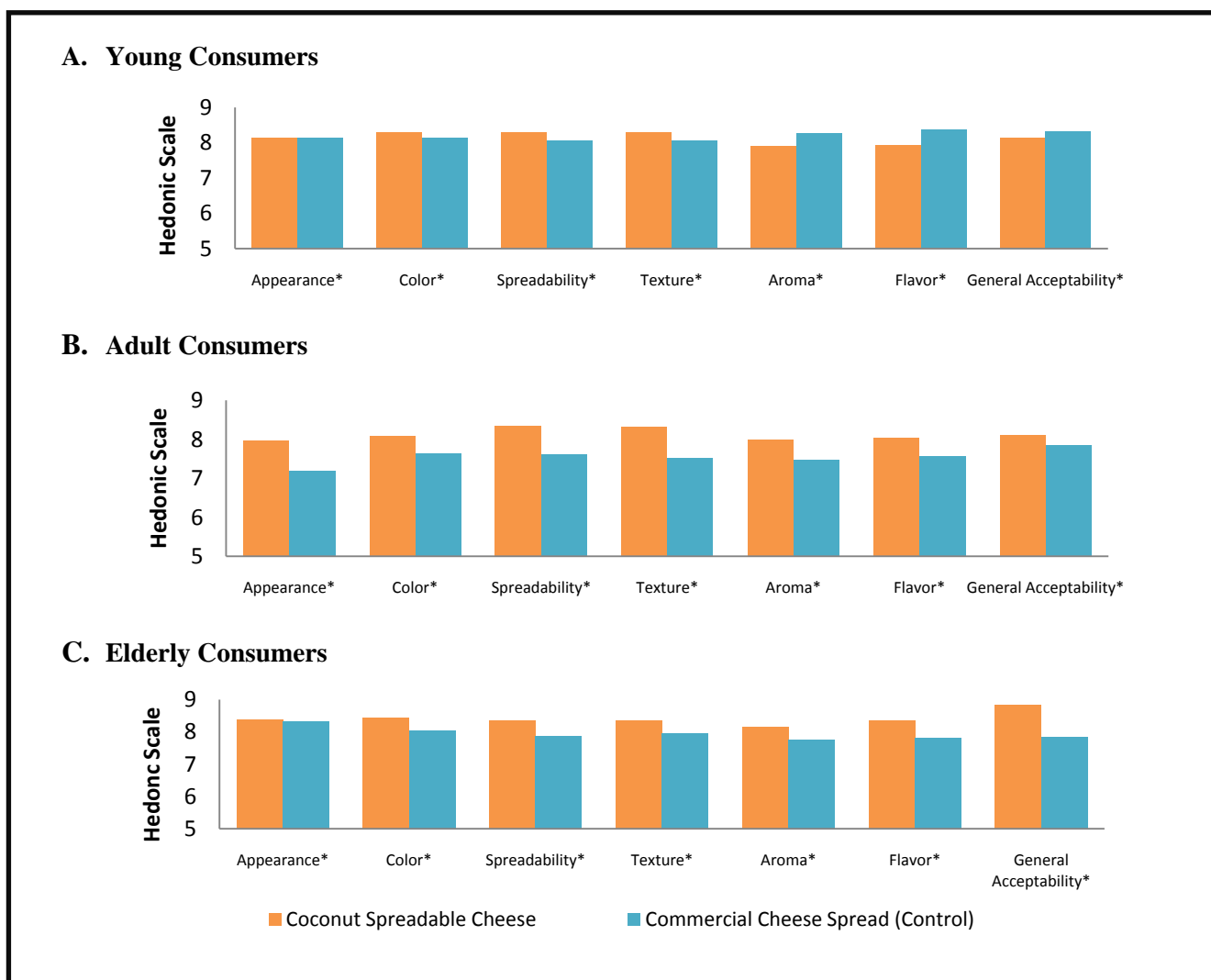


Figure 1: Sensory Preference of Coconut Spreadable Cheese Substitute over Commercial Cheese Spread
* - significantly different at T-test ($P > 0.05$)

3.2 Sensory Acceptability Comparison of Young, Adults and Elderly Consumers on Coconut Spreadable Cheese Substitute

Three different groups of consumer panellists, namely young, adults and elderly assessed the sensory acceptability of CSCS. Seven sensory attributes were determined, namely appearance, color, aroma, spreadability, texture, flavour and general acceptability. Analysis of variance results showed that there is no significant difference in terms of all attributes ($P > 0.05$) among the three different group of panellists.

Elderly consumers have the highest sensory acceptability for appearance, color, aroma, spreadability, texture, flavour and general acceptability. The sensory acceptability value ranges from 7.90 to 8.42 among young, adult and elderly consumers in a 9-point hedonic scale. This high sensory rating could be attributed to less salty taste and smoother texture of CSCS.

Table 1: Sensory Acceptability of Coconut Spreadable Cheese Substitute among Different Age Group Consumers

Sensory Attributes	Consumers		
	Young	Adults	Elderly
Appearance ^{ns}	8.12	7.96	8.38
Color ^{ns}	8.28	8.08	8.42
Aroma ^{ns}	7.90	8.00	8.16
Spreadability ^{ns}	8.28	8.34	8.36
Texture ^{ns}	8.28	8.32	8.34
Flavor ^{ns}	7.92	8.04	8.34
General Acceptability ^{ns}	8.14	8.10	8.38

^{ns} - not significantly different based on Analysis of Variance (ANOVA)

3.3 Physico-chemical Composition of Coconut Spreadable Cheese Substitute and Commercial Cheese Spread

The pH of the CSCS and commercial cheese spreads were 5.88 and 5.70 respectively, which were not significantly different ($P > 0.05$). This lower pH indicates that microbial shelf life would be higher risk for cheese spreads. It is well established that the texture of processed cheese varies with pH [10]. Low pH cheese are firm whereas high pH products are moist and spreadable [11].

The titratable acidity (TA) of CSCS was found to be significantly lower with a TA value of 0.1464% than the commercial cheese spread with TA value of 2.093%. TA and pH is dependent on the total quantity of acids as well as the strength of the acids present [18]. Thus, pH and titratable acidity is inversely related to each other as there are more acids being produced by the product, its pH value decreases.

The viscosity of CSCS and the commercial cheese spread were 89,633 and 141,000 centipoise at 21°C, respectively, wherein the commercial cheese spread was found to be significantly higher than the CSCS. Viscosity, in general meaning, of processed cheeses, cheese analogues and natural cheeses uses various techniques of viscometry [5]. The increase in viscosity reflects intermolecular interactions between adjacent protein molecules with the formation of weak transient networks [20], therefore high protein content can be associated with viscosity. The results state that the commercial cheese spread is more viscous than the CSCS, relative to the results of the commercial spread having a higher protein percentage than the CSCS.

Free fatty acids was found to be significantly lower in CSCS (0.41%) than the commercial cheese spread (6.81%) because free fatty acids (FFAs) are naturally present at low amounts in all vegetable oils [4]. Since the CSCS contains coconut milk, it can lead therefore to resulting to a low FFAs value. Dayrit *et al.* (2007) also stated that high moisture increases hydrolysis, which leads to a higher free fatty acid content and hydrolytic rancidity and it proves the result of commercial cheese spread.

The water activity (A_w) of the CSCS and commercial cheese spreads were 0.760 and 0.832 respectively. A_w was proposed as an appropriate index for cheese quality determination [6]. A_w is an indication of food perishability. It has a profound effect on the liability of a food to undergo microbial, enzymatic or non-enzymatic spoilage. The levels of water activity that contribute to food spoilage vary depending on the type of food [27].

The moisture content (MC) of CSCS was significantly lower than the commercial cheese spread, wherein the results were 30.68% and 55.61%, respectively. According to Sanchez and Rasco (1983), substitution of coconut milk for skim milk lowers the MC. The CSCS was made with pure coconut milk, thus obtaining a lower MC. Moisture content is an important parameter because it influences the cheese's texture, including softness, elasticity and low susceptibility to compression fractures [15].

Fat content of the CSCS and commercial cheese spread were 6.89% and 21.00% respectively. Fat content of CSCS was significantly lower because increasing the starch content of imitation cheese caused an increase in cheese hardness and this increase could partly be attributed to the reduction in fat [3] and starch content of CSCS was relatively higher causing the fat to be lower than the commercial sample.

The ash content was significantly higher in commercial cheese spread with 5.76 than CSCS with 2.52%. The significance of the ash content in food samples cannot be overemphasized as they account for the mineral constituents in a product sample [8]. The amounts of specific minerals in different cheese types are influenced by addition of salt [26]. Since the commercial cheese spread tends to be much saltier than the CSCS, it can be said that it contains more salt than the CSCS, resulting in higher ash content.

Protein content of CSCS was significantly lower with 1.15% than the commercial cheese spread with 12%. Carbohydrate content of CSCS however was significantly higher with 58.76% than the commercial cheese spread with 11%. The dissimilarity of protein and carbohydrate content between CSCS and commercial cheese spread are mainly because of its difference in formulations. The main effect on chemical composition was associated with the different milk types used [12].

Table 2: Physico-chemical Composition (Mean ± SD) of Coconut Spreadable Cheese Substitute vs. Commercial Cheese Spread

Physico-chemical	Coconut Spreadable Cheese Substitute	Commercial Cheese Spread
pH ^{ns}	5.88 ± 0.06	5.70 ± 0.13
TA (%) *	0.1464 ± 0.05	2.093 ± 0.03
Viscosity (cP) *	89633 ± 0.001	141000 ± 0.001
Free Fatty Acids (%) *	0.41 ± 0.02	6.81 ± 0.01
Water Activity *	0.760 ± 0.01	0.832 ± 0.01
Moisture (%) *	30.68 ± 0.72	55.61 ± 2.40
Fat (%) *	6.89 ± 0.01	21 ± 0.001
Ash (%) *	2.52 ± 0.08	5.76 ± 0.01
Protein (%) *	1.15 ± 0.001	12.00 ± 0.001
Carbohydrate (%) *	58.76 ± 0.001	11.00 ± 0.001

* – significantly different, ^{ns} – not significantly different based on T-test (P>0.05)

4. CONCLUSIONS

The sensory properties between CSCS and commercial control cheese spreads were significantly different from each other, with adult and elderly consumers favouring the CSCS over the commercial cheese spread. Consumer acceptability of CSCS among the three groups of consumers was not significantly different. The CSCS can therefore be commercially acceptable and can be a substitute to cheese spreads available in the market. Results obtained from the physico-chemical compositions showed that CSCS differ significantly (at P>0.05) from the commercial control sample in all the parameters except for pH. However, acceptability of either the CSCS or the commercial sample could be related to significant differences in the content of the milk used in the formulation of cheese spreads which affects its flavor. In conclusion, coconut milk is an ideal ingredient as milk substitute in cheese spread.

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