



Research Article

Physico-Chemical Qualities, Nutrition Facts and Shelf-Life Evaluation of The Developed Cookies Flavored with Turmeric (*Curcuma longa*)

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ABSTRACT

Cookies are a widely popular snack that is consumed by all ages, from children to adults. Cookies can be used to increase nutrition for children, such as dietary fibre, protein, and other functional purposes, because they can be combined with various food ingredients or supplements. The study aims to determine the physico-chemical analysis, nutrition facts, shelf-life capability, packaging material and the cost benefit analysis of the developed cookies flavored with turmeric that can be utilized in the community. Sampling procedure was based on the most acceptable formulation, assessment of physico-chemical analysis, nutrition facts, and shelf-life capability and packaging materials and direct material cost. The results showed that the nutritional composition of the developed cookies flavored with turmeric shows the amount of 2.3 kcal per serving, which is relatively low and common for snack-sized portions by a single 10g serving of the product, a low-fat, low-sodium snack. The nutritional value is within the acceptable limits for human consumption and beneficial to human health. During the one-month long-term storage periods, the PE and PP packing materials assist the product's sensory attributes stay within the permissible range. The results of the cost and benefit study indicated that cookies flavored with turmeric may be manufactured and sold at a lower cost, making them a viable substitute for cookies that are already on the

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market. The created product had good nutritional qualities and could be used as a means of transferring nutrients, allowing it to have a 30-day shelf life without sacrificing its sensory qualities.

Keywords Cookies flavored with turmeric (*Cucurma longa*), Cost benefit analysis, Nutritional value, Physico chemical analysis, Shelf-life capability

Introduction

Cookies are a widely popular snack that is consumed by all ages, from children to adults. Cookies also have an advantage over other baked products since they have low water content, a longer shelf life, and are affordable. Cookies can be used to increase nutrition for children, such as dietary fiber, protein, and other functional purposes, because they can be combined with various food ingredients or supplements (Sulieman et al., 2019) Cookies packed as a desirable snack infused with Turmeric as new delicacy for both young, adults and elderly people to serve as a vehicle for important nutrients. (Muyot N. et al., 2023) Cookies are associated as the source of energy and are a product that is ready to be consumed. Moreover, cookies can also be produced in high numbers with a short time, and it is easy to be widely distributed (Zucco et al., 2011) Food and other industries recently focused on natural additives rather than chemicals due to health hazards therefore turmeric is one of the most important alternates which is abundantly and easily extractable natural safe oil used worldwide. Value addition of existing foods like cookies with such ingredients is a simple and feasible way of enhancing nutritional values of foods and add variety to snacking with health. Cookies enriched with natural plant can provide numerous health benefits and have a high potential for commercialization in both domestic and foreign markets. Food and Agricultural Organization (FAO, 2012) have identified the necessity for the development and utilization of low-cost local resources in the development of popular goods like cookies.

The association between health and food had an expanding influence on food modernization due to the publicity of the conception of techno-functional foods. The way of employing nutritious information in foodstuffs is to enhance the health of buyer types (Peressini and Sensidoni, 2009) Snack food consumption has been on the increase as a result of urbanization and increase in the number of working women (Hooda, S & Jood S. 2005). The food industry has taken cue from this development hence; efforts have been focused on the production of cookies. Cookies have become one of the most desirable snacks for both youth and elderly people due to their low manufacturing cost, more convenience, longer shelf-life and ability to serve as a vehicle for important nutrients (Akubor, 2003). Food and other industries recently focused on natural additives rather than chemicals due to health hazards therefore turmeric is one of the most important alternates which is abundantly and easily extractable natural safe oil used worldwide. (Muyot, N. et al., 2023) The low price and excellent nutritional content of cookies make them a popular bakery-based product. A ready-to-eat source of rapid energy is a cookie. Moreover, the vast majority of the cookies produced possess a longer shelf life in comparison to other well-liked baked goods. Their low water activity levels may be the cause of this. Cookies typically require three basic ingredients: flour, sugar, and fat. (Turksoy S O B. 2011) Cookies with functional ingredients are becoming increasingly popular, particularly in the food and

beverage industry. Cookies enriched with natural plant extracts can provide numerous health benefits and have a high potential for commercialization in both domestic and foreign markets (Renzo, A., et al. 2023) It represents the largest category of snack item among baked food products throughout the world (Muyot, N. et al., 2023).

The nutrient composition of foods is important in areas of nutrition and health, and other related disciplines such as food science, agriculture and trade. In the country, the Philippine Food Composition Tables (FCT) 1997 is the current publication of the nutrient data of foods (Rodriguez, G et al., 2020). The development efforts of commercialization of cookies into functional food must be supported with clear information of the nutrition, physical and sensory properties. Recent pharmaceutical studies suggest that turmeric outperform many pharmaceuticals in a wide range of chronic degenerative diseases, (Dan, 2013). Turmeric rhizome has been shown to have a high medicinal potential and is traditionally (regularly) used in Asian cuisine as a spice, natural preservative, and for providing color to the food (Hamid NS (2014). The medical benefits provided by turmeric are generally due to the presence of curcuminoid compounds in turmeric, such as curcumin, bisdemethoxycurcumin (BDMC), and demethoxycurcumin (DMC) compounds (Aggrawal BB, et al, 1003). Curcumin, a polyphenolic compound, has also been shown to work in the body by targeting several signaling molecules and exhibiting activity at the cellular level, which has helped support its various health benefits. Food and other industries recently focused on natural additives rather than chemicals due to health hazards therefore turmeric is one of the most important alternates which is abundantly and easily extractable natural safe oil used worldwide. The spice is the essential ingredient in curries but can be used as flavoring in a wide range of preparations including juices, beverages and baked products (DOH, 2010). Aside from offering a unique taste, may also provide several potential health benefits, largely due to the active compound in turmeric, curcumin, as well as the other ingredients that may be included in the cookies. There is a knowledge gap in the use of turmeric to enhance the nutritional quality of bakery items, such as cookies. The use of turmeric containing bioactive compounds which will enrich nutritionally cookies is therefore of great importance. In the study of Muyot, N. et al, 2022, Sensory Qualities of Cookies Flavored with Turmeric (*Curcuma Longa*), an experimental research focused on the preparation and subsequently sensory evaluation of cookies flavored with turmeric (*curcuma longa*) terms of the sensory qualities color, texture, aroma and taste and testing whether there existed significant differences in terms of these sensory qualities when three different treatments were used namely, treatment one- using grated fresh turmeric, treatment 2 using turmeric oil and treatment 3 using turmeric powder. Three replications were made for each treatment and there were 135 sensory evaluators distributed at 15 evaluators per replication. Results of the study revealed that treatment two, using turmeric oil as flavoring had the highest overall mean in the sensory evaluation found on the color of the cookies prepared using the various treatments with an interpretation of like very much.

Normally, cookies have a longer shelf life with lower moisture content. Since most low-moisture food products have a shelf life of several weeks or even months, actual storage testing, which uses a long-term stability study that involves storing a packaged product under typical storage conditions and examining the product at regular time intervals, is expensive and time-consuming for low-moisture food products. For a low-moisture food product, actual storage testing by a long-term stability study involves storing a packaged product under typical storage conditions and examining the product at regular time intervals.). Since most low-moisture food products have a shelf life of several weeks or even months, actual storage testing, which uses a long-term stability study that involves storing a packaged product under typical storage conditions and examining the product at

regular time intervals, is expensive and time-consuming for low-moisture food products. Moreover, long shelf-life studies do not fit with the speed requirement of the food industry and therefore shelf-life simulations have been developed (Hernandez and Giacin 1997; Lee and Resurreccion 2006). Shelf-life determination is of great importance for the food industry to ensure that the consumer will obtain a high-quality product for a certain period of time after purchase. For the delivery of a product with maximum quality, the shelf-life of the packaged food product should be determined (Sirpatrawan, U., 2009) According to Bodwitch 1997, flexible plastic films have relatively low cost and good barrier properties against moisture and gases; they are heat sealable to prevent leakage of contents; they add little weight to the product and they fit closely to the shape of the food, thereby wasting little space during storage and distribution; they have wet and dry strength, and they are easy to handle and convenient for the manufacturer, retailer and consumer. Consumers motivated by health trends make different choices in the food rather than other population segments. Health-conscious consumers like eating foods with vastly different characteristics than consumers motivated by price convenience, mood or familiarity as reported by Winger & Wall (2006).

The study aims to determine the physico-chemical analysis, nutrition facts, shelf-life capability, packaging material and the cost benefit analysis of the developed cookies flavored with turmeric that can be utilized in the community.

Materials and Methods

The research design used in this study was experimental method where variables were predicted and manipulated depending on the data gathered. There were three phases of the study namely:

Phases of the Study

A. Sampling Procedure of the developed Cookies flavored with Turmeric

(Formulation was based on the most acceptable formulation of the developed Cookies flavored with Turmeric, Muyot N et al.,2023)

All ingredients' materials will be purchased in San Jose Public, Market San Jose Occidental Mindoro; and preparation of samples will be prepared at TLE Laboratory CTE OMSC San Jose Campus, San Jose Occidental Mindoro. Formulation of cookies is Treatment -flour, baking powder, salt, butter, turmeric oil, peanuts, sugar, vanilla extract, egg and Lemon Zest. The developed formulation will be weighed and packed using packaging materials. One replication per treatment were prepared. The procedure used in the preparation of the turmeric-flavored cookies.

Procedure:

- 1.Prepare all the ingredients.
- 2.In a medium bowl mix together sifted flour, baking powder and salt.
- 3.In a bowl of stand mixer fitted with the paddle attachment, add the following ingredients: Treatment - cream the butter, turmeric oil, peanut, sugar and vanilla extract.
- 4.Wait until the mixture becomes light brown and fluffy for about 2 minutes, scraping down the sides as needed. Add egg, beat well.

5. Add the flour mixture, beat well to combine.

Baking:

1. Preheat oven to 375 degrees F (175 degrees C) and line two baking sheets with parchment paper or wax paper.

2. Drop 2 to 3 tablespoon mounds of dough onto the baking sheets, spacing the mounds at least 2 inches apart.

3. Bake the cookies for 9 to 11 minutes, or until golden brown. Cool the cookies on the baking sheets for 2 minutes then transfer them to wire rack to cool completely.

B. Physico-chemical analysis of the developed Cookies flavored with Turmeric

The physico-chemical analysis of the developed cookies flavored with Turmeric will be prepared according to the required sample size of Service Laboratory.

C. Nutrition facts of the developed Cookies flavored with Turmeric

The computation & drafting nutrition facts of the developed cookies flavored with Turmeric will be prepared proximate analyses of Food Composition per 100g Edible portion from Department of Science and Technology Food and Nutrition Research Institute.

D. Shelf-life capability and packaging material of the developed Cookies flavored with Turmeric

For the Shelf-life capability and packaging material, approximately 10g of the developed cookies flavored with turmeric will be carried out using two types of packaging materials including polyethylene (PE) and polypropylene (PP) films formed into 1half metallic half clear stand-up resealable pouch and sealed through electric sealer. Products will be packed individually and will be stored at three types of environments, room temperature, chilled temperature and combined temperature and will be assessed by 1 day, 1week and 1month. These will be evaluated for various sensory characteristics, appearance, aroma, color, taste, texture using 7 point and overall acceptability using 9-point hedonic rating scale by panel of 10 semi trained panelists form the Bachelor of Technology and Livelihood Education major in Home Economics students.

Statistical Tools

To assess the researchers used the weighted mean and analysis of variance (ANOVA) to test the difference in the sensory qualities of the cookies using the various treatments.

E. Direct material cost of Cookies flavored with Turmeric

Affordability is one factor most consumers choose to buy a certain product. The cost of the cookies flavored with Turmeric consisted of the direct material cost and will be based on the prevailing prices of the raw materials in the market at the time of the study using cost benefit analysis.

Results and Discussion

A. Physico-chemical analysis of the developed Cookies flavored with Turmeric

The physico-chemical analysis of the developed cookies flavored with turmeric reveals the following composition per 100g and per 10g serving. In terms of macronutrients, the cookies contain 20.1g of fat, 4.5g of moisture, 2.8g of ash, and 7.9g of protein per 100g. Carbohydrates make up 64.7g of the total weight. When scaled to a 10g serving, the fat content is 2.01g, moisture is 0.45g, ash is 0.28g, protein is 0.79g, and carbohydrates are 6.47g. The caloric content per 100g is 471.3 kcal, which translates to 47.13 kcal per 10g serving.

Cookies flavored with turmeric are primarily carbohydrate-based, with a moderate fat content and a decent protein contribution. The relatively low moisture and ash content suggest that the product has a firm texture and minimal mineral content. The high caloric value per 100g reflects the dense energy content, which is consistent with the amount of fat and carbohydrates in the product. Overall, the cookies flavored with turmeric provide a significant amount of energy, making them a calorie-dense snack option.

Table 1. Physico- chemical analysis of the developed Cookies flavored with Turmeric

Analyte (s)	Result (s) per 100g	Result (s) per 10g
Fat	20.1	2.01
Moisture	4.5	.45
Ash	2.8	.28
Protein	7.9	.79
Carbohydrates	64.7	6.47
Calories	471.3	47.13

B. Nutrition facts of the developed Cookies flavored with Turmeric

The nutritional composition of the developed cookies flavored with turmeric are tabulated in Table 2. The analysis shows that each 10g serving contains just 2.3 kcal, with 2.01 kcal coming from fat. The cookies contribute minimally to the daily value of various nutrients, with total fat making up only 0.10% of the daily value, and saturated fat, trans fat, and cholesterol contributing 0.00%. Sodium is also extremely low, at 0.01% of the daily value. The carbohydrate content is similarly low, contributing just 0.32% of the daily value, and there is no significant amount of dietary fiber or sugar (both contributing 0.00% to the daily value).

These cookies are very low in calories and fats, making them a light snack option. However, they do not significantly contribute to daily nutritional needs in terms of fats, sugars, or carbohydrates. As such, they may be suitable for individuals seeking a minimal-calorie snack or for those who are mindful of their fat and sugar intake.

Table 2. Nutrition Facts of the developed Cookies flavored with Turmeric

Serving size 10g	
AMOUNT PER SERVING	
Calories (Energy):	2.3
	Cal from fat: 2.01
	% Daily Value
Total Fat	.10%
Saturated fat	.00%
Trans Fat	.00%
Cholesterol	.00%
Sodium	.01%
Total Carb	.32%
Dietary fiber	.00%
Sugar	.00%

*Percent Daily Values are based on a 2,000-calorie diet

C.Shelf-life capability and packaging material of the developed Cookies flavored with Turmeric

Shelf-capability and packaging materials need to be explored to retain the health benefits of such products. The shelf life of a food product refers to the length of time for which it can be stored, under specified conditions, while remaining in optimum condition and safe for consumption. Estimated shelf life is based on ideal storage conditions (Fact Sheet Food, 2020)

Table 3.a. Shelf-life capability and packaging material of the developed Cookies flavored with Turmeric using Polyethylene (PE) films

	Appearance (mean ± SD) QD	Aroma (mean ± SD) QD	Color (mean ± SD) QD	Taste (mean ± SD) QD	Texture (mean ± SD) QD	Over All Acceptability (mean ± SD) QD
Room Temperature: 20-22 °C (68-72 °F)						
Day 1	6.95 ± .24 LVM	6.54 ± .57 LVM	6.81 ± .51 LVM	6.71 ± .54 LVM	6.70 ± .42 LVM	8.80 ± .71 LE
Week 1	6.89 ± .76 LVM	6.52 ± .81 LVM	6.78 ± .34 LVM	6.66 ± .51 LVM	6.56 ± .68 LVM	8.48 ± .45 LVM
Month 1	6.50 ± .51 LM	6.50 ± .49 LM	6.54 ± .67 LVM	6.51 ± .52 LVM	6.49 ± .55 LM	8.46 ± .33 LVM
Chilled Temperature: 1- 7 °C (34 to 45 °F)						
Day 1	6.92 ± .36 LVM	6.61 ± .71 LVM	6.87 ± .52 LVM	6.62 ± .41 LVM	6.75 ± .62 LVM	8.87 ± .76 LE
Week 1	6.85 ± .17 LVM	6.60 ± .33 LVM	6.85 ± .45 LVM	6.59 ± .40 LVM	6.60 ± .45 LVM	8.46 ± .84 LVM
Month 1	6.49 ± .28 LM	6.45 ± .56 LM	6.56 ± .48 LVM	6.53 ± .84 LVM	6.50 ± .51 LM	8.43 ± .31 LVM
Combined Temperature (Alternate)						
Day 1	6.57 ± .31 LVM	6.53 ± .74 LVM	6.78 ± .55 LVM	6.64 ± .61 LVM	6.60 ± .45 LVM	8.85 ± .74 LE
Week 1	6.56 ± .25 LM	6.52 ± .53 LVM	6.56 ± .51 LVM	6.57 ± .50 LVM	6.51 ± .42 LVM	8.45 ± .56 LVM
Month 1	6.46 ± .54 LM	6.35 ± .24 LM	6.53 ± .37 LVM	6.46 ± .62 LM	6.48 ± .50 LM	8.32 ± .21 LVM

Legend: MS-Mean Score; SD-Standard Deviation; QD- Qualitative Description; Scale of Interpretation: 7 Point Hedonic Rating Scale: 7-6.51= Like Very Much(LVM) ; 6.50-5.51=Like moderately(LM); 5.50-4.51= Like slightly(LS); 4.50-3.51=Neither like nor Dislike(NLD); 3.50-2.51= Dislike (D); 2.50-1.51= Dislike Moderately(DM) ; 1.50-1.00-Dislike Moderately(DM) 9 Point Hedonic Rating Scale: 9.0-8.51 = Like Extremely(LE); 8.50 -7.51= Like Very Much(LVM); 7.50-6.51 =Like Moderately(LM); 6.50-5.51= Like Slightly(LS); 5.50-4.51 = Neither like nor

Dislike(NLD); 4.50-3.51 =Dislike Slightly(DS); 3.50-2.51 = Dislike Moderately(DM); 2.50-1.51 = Dislike Very Much(DVM); 1.50-1.0 =Dislike Extremely(DE)

Table 3a reflects the results of the Shelf-life capability and packaging material of the Cookies flavored with turmeric using Polyethylene (PE) films using sensory evaluation for day 1, week 1 and month 1 rated by 10 semi-trained panelists. It can be observed that the appearance providing the rating $6.95 \pm .24$, $6.92 \pm .36$ and $6.57 \pm .31$, from day 1 three different temperature obtained a qualitative description of ***Like Very Much*** together with week 1 of room temperature and chilled temperature, other rating obtained a qualitative description of ***Like Moderately***. In terms of aroma, it can be observed that ratings day 1 and week1 ranging from $6.52 \pm .53$ to $6.61 \pm .71$ of room temperature, chilled temperature and combined temperature obtained a qualitative description of ***Like Very Much***, while other rating from month 1 of room temperature, chilled temperature and combined temperature obtained ***Like Moderately***. In terms color of it can be seen in the table that all rating from room temperature, chilled temperature and combined temperature obtained a qualitative description of ***Like Very Much*** except rating from month 1 of combined temperature rated of ***Like Moderately***. In terms of taste, ratings from day 1 and week 1 of three different temperature obtained a qualitative description of ***Like Very Much*** except month of three different temperature got ***Like Moderately***. In terms of texture, it can be observed that day 1 and week1 from three different temperature got rating ranging from $6.51 \pm .42$ to $6.75 \pm .62$ rating for day 1 and week 1 of three different temperature obtained a qualitative description of ***Like Very Much***, while other rating from month 1 of three different temperature obtained ***Like Moderately***. In terms of overall acceptability, it can be observed that the rating of day 1 from room temperature $8.80 \pm .71$, chilled temperature $8.87 \pm .76$, and combined temperature $8.85 \pm .74$, obtained a qualitative description of ***Like Extremely***, while other ratings obtained ***Like Very Much*** by the panelists. The results show the shelf-life capability of cookies flavored with turmeric using Polyethylene (PE) films could be stored best under room temperature and chilled temperature and still on its acceptability level on combined temperature until 30 days.

Table 3.b. Shelf-life capability and packaging material of the developed Cookies flavored with Turmeric using Polypropylene (PP) films

	Appearance (mean ± SD) QD	Aroma (mean ± SD) QD	Color (mean ± SD) QD	Taste (mean ± SD) QD	Texture (mean ± SD) QD	Over All Acceptability (mean ± SD) QD
Room Temperature: 20–22 °C (68–72 °F)						
Day 1	$6.96 \pm .61$ LVM	$6.57 \pm .54$ LVM	$6.87 \pm .56$ LVM	$6.84 \pm .55$ LVM	$6.72 \pm .44$ LVM	$8.87 \pm .76$ LE
Week 1	$6.90 \pm .52$ LVM	$6.53 \pm .61$ LVM	$6.84 \pm .54$ LVM	$6.77 \pm .65$ LVM	$6.67 \pm .71$ LVM	$8.74 \pm .67$ LE
Month 1	$6.54 \pm .77$ LVM	$6.52 \pm .53$ LVM	$6.72 \pm .42$ LVM	$6.61 \pm .57$ LVM	$6.49 \pm .53$ LM	$8.49 \pm .32$ LVM
Chilled Temperature: 1–7 °C (34 to 45 °F)						
Day 1	$6.93 \pm .30$ LVM	$6.63 \pm .34$ LVM	$6.89 \pm .55$ LVM	$6.78 \pm .54$ LVM	$6.76 \pm .65$ LVM	$8.79 \pm .79$ LE
Week 1	$6.87 \pm .24$ LVM	$6.53 \pm .51$ LVM	$6.81 \pm .60$ LVM	$6.71 \pm .51$ LVM	$6.73 \pm .58$ LVM	$8.65 \pm .87$ LE
Month 1	$6.64 \pm .48$ LVM	$6.51 \pm .59$ LVM	$6.69 \pm .52$ LVM	$6.66 \pm .74$ LVM	$6.50 \pm .59$ LM	$8.50 \pm .35$ LVM
Combined Temperature (Alternate)						
Day 1	$6.62 \pm .64$ LVM	$6.60 \pm .54$ LVM	$6.93 \pm .54$ LVM	$6.73 \pm .65$ LVM	$6.69 \pm .56$ LVM	$8.85 \pm .77$ LE
Week 1	$6.55 \pm .48$	$6.53 \pm .52$	$6.82 \pm .61$	$6.53 \pm .63$	$6.56 \pm .39$	$8.64 \pm .58$

Month 1	LVM LVM	LVM LVM	LVM LVM	LVM LM	LVM LM	LE LVM
	6.53 ± .61	6.52 ± .33	6.79 ± .71	6.51 ± .59	6.48 ± .73	8.45 ± .34

Legend: MS-Mean Score; SD-Standard Deviation; QD-Qualitative Description; Scale of Interpretation: 7 Point Hedonic Rating Scale: 7-6.51= Like Very Much(LVM) ; 6.50-5.51=Like moderately(LM); 5.50-4.51= Like slightly(LS); 4.50-3.51=Neither like nor Dislike(NLD); 3.50-2.51= Dislike (D); 2.50-1.51= Dislike Moderately(DM) ; 1.50-1.00-Dislike Moderately(DM) 9 Point Hedonic Rating Scale: 9.0-8.51 = Like Extremely(LE); 8.50 -7.51= Like Very Much(LVM); 7.50-6.51 =Like Moderately(LM); 6.50-5.51= Like Slightly(LS); 5.50-4.51 = Neither like nor Dislike(NLD); 4.50-3.51 =Dislike Slightly(DS); 3.50-2.51 = Dislike Moderately(DM); 2.50-1.51 = Dislike Very Much(DVM); 1.50-1.0 =Dislike Extremely(DE)

Table 3b reflects the results of the Shelf-life capability and packaging material of the Cookies flavored with turmeric using Polypropylene (PP) films using sensory evaluation for day 1, week 1 and month 1 rated by 10 semi-trained panelists. It can be observed that the appearance providing the rating ranging from $6.53 \pm .61$ to $6.96 \pm .61$ from three different temperature rature of day 1, week 1 and month 1 obtained a qualitative description of **Like Very Much**. In terms of aroma, it can be observed that ratings day 1, week 1 and month 1 ranging from $6.51 \pm .59$ to $6.63 \pm .34$ of three different temperature obtained a qualitative description of **Like Very Much**. In terms color of it can be seen in the table that all rating from three different temperature obtained a qualitative description of **Like Very Much**. In terms of taste, ratings from day 1 and week 1 and month 1 of three different temperature obtained a qualitative description of **Like Very Much**. In terms of texture, it can be observed that day 1 and week1 from room temperature, chilled temperature and combined temperature got rating ranging $6.56 \pm .39$ to $6.76 \pm .65$ from rating for day 1 and week 1 of three different temperature obtained a qualitative description of **Like Very Much**, while other rating from month 1 of three different temperature obtained **Like Moderately**. In terms of overall acceptability, it can be observed that the rating of day 1 and week 1 from room temperature $8.87 \pm .76$; $8.74 \pm .67$, chilled temperature $8.79 \pm .79$; $8.65 \pm .87$ and combined temperature $8.85 \pm .77$; $8.64 \pm .58$, obtained a qualitative description of **Like Extremely**, while ratings from month 1 of three different temperature obtained **Like Very Much** by the panelists. The results show the shelf-life capability of cookies flavored with turmeric using Polypropylene (PP) films could be stored best under room temperature and chilled temperature and still on its acceptability level on combined temperature until 30 days.

D.Cost Benefit Analysis of the developed Cookies flavored with Turmeric

The cost benefit analysis of the developed Cookies flavored with Turmeric was evaluated by presenting the direct material incurred in producing the Cookies flavored with Turmeric, the composition of the raw materials was based on the most acceptable formulation from the previous study. Table 4.a shows the computation for the direct and indirect cost of producing the Cookies flavored with Turmeric.

Table 4.a. Direct and Indirect Material Cost of the developed Cookies flavored with Turmeric

Raw Materials	Direct Cost		Indirect Cost	
	Unit Cost (Php/kg)	Total Cost (Php)	Operating Cost	Cost (Php)
Flour	60.00/kg	14.40	Laborer	150.00
Skim Milk	105.00/kg	10.50	Water and Electricity	150.00
Butter	54.00/200g	16.20	Gas	150.00
Nuts	90.00/kg	5.40	Packaging and Labeling	25.00
Egg	10.00/10g	10.00	Contingency Cost 10% of Direct Cost	19.62
Sugar	94.00/kg	11.28		
Baking Powder	30.00/50g	9.00		
Vanilla	427.00/475ml	13.48		
Turmeric Oil	105.00/15ml	105.00		
Salt	10.00/50g	1.00		
TOTAL	640	Total Direct Cost	196.26	
No. of pcs produced	128		Total Indirect Cost	644.62

**640g of total weight makes each dropped cookies 5g making it 128 pcs of cookies which weighs 10g after baking

Table 4a reflects the cost entailed in producing and packaging the developed Cookies flavored with Turmeric. The table shows that the total cost of raw materials is Php 196.26 while the indirect material cost accounting for the cost of producing Cookies flavored with Turmeric amounted to Php 644.62. The developed Cookies flavored with Turmeric has total weight of 640g and single dropped cookie weighs 5g each, after cooking the cookie weighs 10g and yielded 128 pcs of cookies. The indirect cost includes the wages of the laborer, the water and electricity cost used during the production, the gas used in the burner, the packaging and labelling materials and the contingency cost. The contingency cost of 10% of the direct material cost was accounted to deal with the uncertain or unexpected circumstances or events that may arise during the project commercialization. The number of packs produced considering the direct and indirect cost was used in determining the selling price of the product and the breakdown is reflected as Table 4b.

Table 4.b. Suggested selling price of developed Cookies flavored with Turmeric

Operating Cost	Cost (Php)
Total Direct	196.26
Total Indirect	644.62
Total Production	840.88
Peso Mark -Up (10%)	84.08
Total Production cost	924.96
Total Produce Yield (pcs)	128
Total Selling Price per 10g	7.22

**Total Cost = Total Production Cost +Peso Mark Up/Number of Yield

Table 4b shows the summary of costs used in deriving the selling price of the developed Cookies flavored with Turmeric. The majority of consumer goods were given a 10% markup, which allows distributors, wholesalers, and retailers to recoup the costs associated with importing machinery, supplies, or completed goods. These costs include import duties, Value Added Tax (VAT), customer discounts, commissions paid to independent provincial dealers and company-employed agents, warehousing fees, shipping costs (some of which are borne by the importer), and other Bureau of Customs fees (International Trade Administration, 2024). The recommended selling price, after taking into account the production costs, is just Php 7.22, which is Php 2.78 less than the price of a 10g cookies purchased from a store for Php 10.00.

Discussion

Cookies flavored with turmeric, when made with quality ingredients and consumed in moderation, may offer a range of health benefits, particularly due to the anti-inflammatory and antioxidant properties of turmeric. The purpose of the study was to determine how well the produced cookies flavored with turmeric would work in terms of physico-chemical analysis, shelf life, nutritional value, packaging, and economic feasibility. The researchers were able to investigate cookie-related products and create goods that may take the place of the current cookies attributed to the ongoing research into the product produce from the developed cookies flavored with turmeric. The nutritional value results showed the advantages of consuming cookies flavored with turmeric for the consumer's health. Nevertheless, the created product's shelf life and packaging capacity indicated that it might be packaged for human consumption and retain its health benefits for an extended period of time. Additionally, the cost-benefit analysis demonstrated that the product is more cost-effective to sell.

Physico-chemical analysis helps in determining the presence of contaminants, additives, and adulterants in food, as well as evaluating the stability and shelf life of food products. (Martinez, S., & Carballo, J., 2021), results shows that the samples are within the range of detection limit for specified analyte. The nutrition facts of the developed cookies flavored with turmeric shows that cookies flavored with turmeric where nutritionally rich, being added with turmeric, enhance the nutritional quality of cookies. The amount of time a food product has to stay safe and appropriate for ingestion by humans is known as its shelf life (Awulachew, 2021). For the food sector to guarantee that the customer will receive a high-quality product for a specific amount of time following purchase, shelf-life determination is crucial. The shelf-life of the packaged food product should be ascertained in order to give a product of the highest quality possible. The food business was seeing a rise in the use of non-thermal technology, chemical preservatives, and changed atmospheric and temperature-controlled packing techniques as methods of preserving food (Olatunde and Bejakul, 2018). A long-term stability study's real storage testing for a low-moisture food product includes keeping the product packaged under normal storage conditions and checking it on a regular basis. The results of sensory evaluation reveals that quality of the developed cookies flavored with turmeric varies according to its exposure on a certain temperature where it causes sudden change in quality. Results are comparable with the study of Kumari N., et al., 2020 wherein the shelf-life evaluation showed that biscuits could be stored for 6 weeks at the ambient conditions of average temperature at $30\pm1^{\circ}\text{C}$ and RH at 75-80% with acceptable quality. Duta et al., (2019) studied quality of gluten-free oat biscuits for a storage period up to 3 months in different packages. This result is comparable with the study by Labuza and Hyman (1998) who found out that the quality of snack foods

is differs when samples are stored under different conditions. Packaging of foods as a marketing tool is important (Hawkes, C., 2010). The barrier performance of the packaging system employed can influence the packaged product shelf-life (Pajin et al. 2016). Cookies flavored with turmeric packaged in PP pouches had higher shelf-life values than those in PE pouches since PP has lower permeability coefficient.

Analysis of costs and benefits is a traditional approach for decision support in economics. Measuring costs and benefits of quality and food safety improvements (Schiefer S., & de Silva, C., 2017). The cost benefit analysis performed in this study provided the breakdown of cost incurred in producing the developed cookies flavored with turmeric. Price of a certain product influences purchasing factors for consumers. In this study, the direct and indirect cost of producing the developed cookies flavored with turmeric were presented and analyzed carefully. The recommended selling price, after taking into account the production costs, is just Php 7.22, which is Php 2.78 less than the price of a 10g cookies purchased from a store for Php 10.00.

Conclusion

This study evaluated the nutrition facts and shelf life of the cookies flavored with turmeric. The results showed that that the nutritional composition of the developed cookies flavored with turmeric shows the amount of 2.3 kcal per serving, which is relatively low and common for snack-sized portions by a single 10g serving of the product, a low-fat, low-sodium snack. The nutritional value is within the acceptable limits for human consumption and beneficial to human health, cookies flavored with turmeric offers a unique taste and also provide several potential health benefits due to the active compound, curcumin. The developed product's shelf life examination indicated that both its form and substance were sustainable and long-lasting. During the one-month long-term storage periods, the PE and PP packing materials assist the product's sensory attributes stay within the permissible range. The results of the cost and benefit study indicated that cookies flavored with turmeric may be manufactured and sold at a lower cost, making them a viable substitute for cookies that are already on the market. It is recommended that the created product had good nutritional qualities and could be used as a means of transferring nutrients, allowing it to have a 30-day shelf life without sacrificing its sensory qualities. A modest step forward has been made by the study, which has produced proof-of-concept and proof-of-principle for the viability of food product manufacture, marketing, and successful retail.

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Statement of Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. The authors affirm that they have disclosed all potential conflicts of interest, and none exist that could have influenced the outcome or interpretation of the findings.

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