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Study on Development and Quality Control of Composite Flour Coconut Biscuit

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ABSTRACT

The present investigation aimed to develop a nutritionally enriched composite flour biscuit and evaluate its quality in comparison with coconut cookies using proximate composition, mineral analysis, and sensory evaluation. The developed composite biscuit exhibited appreciable nutritional value with moisture (9.59 ± 0.09 g), protein (9.46 ± 0.13 g), fat (1.33 ± 0.07 g), minerals (8.33 ± 0.12 g), crude fibre (3.61 ± 0.07 g), carbohydrates (73.63 ± 0.93 g), and energy (344.22 ± 1.12 kcal) per 100 g. Mineral and vitamin analysis revealed enhanced levels of calcium (149.79 ± 0.49 mg), phosphorus (296 ± 0.69 mg), iron (14.74 ± 0.40 mg), vitamin E (29.27 ± 0.42 mg), and vitamin B3 (2.74 ± 0.39 mg) per 100 g, indicating improved micronutrient density of the composite biscuit.

Sensory evaluation conducted using a 9-point hedonic scale and represented through a spider graph demonstrated that the composite flour biscuit received higher scores for appearance, colour, flavour, texture, taste, and overall acceptability when compared to coconut cookies. The graphical representation clearly illustrated the superior sensory profile and consumer preference for the composite biscuit.

The results confirm that the incorporation of composite flour significantly enhanced the nutritional quality without compromising sensory attributes. Therefore, the developed composite flour biscuit can be recommended as a functional bakery product suitable for promoting improved dietary intake and meeting the needs of health-conscious consumers.

Keywords: Composite flour biscuit, Proximate analysis, Mineral composition, Sensory evaluation, Spider graph, Functional food, 9-point hedonic scale.

INTRODUCTION

The bakery industry plays a crucial role in the food sector that involves the production and marketing of flour-based baked products such as biscuits, bread, cakes, pastries, and cookies. Meeting the growing global demand for a wide variety of baked goods. The industry utilizes various formulations, equipment, and modern processing techniques to produce novel bakery products.

Biscuits are among the most popular ready-to-eat bakery products consumed worldwide by all age groups. Their wide acceptance is attributed to their easy availability, long shelf life, convenience, and variety of flavours, which appeal to consumers and satisfy sweet cravings. Historically, during the medieval period,

early forms of biscuits were prepared by mixing sweeteners and spices, resulting in hard-textured products. In modern times, advancements in the bakery industry have led to the development of a wide range of products such as cookies, crackers, and flavoured biscuits with improved sensory qualities.

Coconut (Cocos nucifera) is one of the most important plants belonging to the family Arecaceae due to its extensive applications in food, culinary, and ornamental purposes. Coconut pulp is highly nutritious and rich in fats, making it valuable for both industrial and dietary consumption. Approximately 70% of global coconut production is used directly or indirectly for local consumption, while the remaining portion is utilized for industrial purposes. Major coconut-producing regions include India, Africa, and Nigeria, where its usage varies depending on regional dietary habits.

The coconut kernel is a rich source of dietary fibre, fats, and long-chain saturated fatty acids, along with essential vitamins such as D, E, and K. It also contains important minerals including potassium, iron, magnesium, phosphorus, copper, and zinc, contributing to its nutritional significance in food formulations.

Wheat (Triticum aestivum L.) is a major cereal crop cultivated worldwide and serves as a staple food for a large portion of the global population. It is rich in carbohydrates and provides approximately 13% plant-based protein, along with essential minerals such as iron and magnesium, and vitamins B and E. Wheat contributes nearly 55% of carbohydrate intake and 20% of total food calories globally. It is widely used in the baking industry as a primary ingredient, often replacing refined all-purpose flour (maida) to improve nutritional quality. Wheat enhances the structure, texture, and appearance of bakery products such as bread, biscuits, cookies, and pasta, making it a fundamental component in bakery formulations.

Ragi, also known as finger millet (Eleusine coracana), is a small, nutrient-dense cereal grain cultivated primarily in the tropical regions of Africa and Asia, particularly in countries such as India and Ethiopia. With the increasing demand for functional and nutritious foods, the food industry has shown growing interest in incorporating traditional grains into bakery products. Ragi is highly valued due to its superior nutritional profile, associated health benefits, and adaptability to diverse climatic conditions. It is an excellent source of dietary fibre, calcium, iron, phosphorus, and essential amino acids such as methionine and tryptophan, which are often deficient in major cereals like rice and wheat. Furthermore, its low glycaemic index and gluten-free nature make it a suitable ingredient for health-conscious consumers and individuals with gluten intolerance. Nutritive values of wheat flour, ragi flour and comparison with maida is mentioned in the table below:1

Jaggery (Gur), as defined by the Food Safety and Standards Authority of India (FSSAI, 2018), is "the product obtained by boiling or processing the juice extracted from sugarcane or from palmyra palm, date palm, or coconut palm." It is a natural and nutritious sweetener that contains essential minerals such as iron, potassium, magnesium, and calcium, along with small amounts of vitamins, making it a healthier alternative to refined sugar. Nutritional information of jaggery and compared with sugar is described in the below Table:2.

Table:1 Nutritive Values of Maida, Wheat, and Ragi

Nutrients (per 100gm)	Maida	Wheat	Ragi
Carbohydrates (gm)	76.0	72.0	72.6
Protein(gm)	10.0	13	7.73
Fat(gm)	1.0	2.0	1.3
Crude Fiber(gm)	2.7	10.7	22.6
Energy (K Cal)	364	340	336

Iron(mg)	1.2	3.9	3.9
Magnesium(mg)	22.0	138.0	154.0
Vitamin B1(mg)	0.1	0.4	0.42
Vitamin B3(mg)	1.3	6.4	1.6

(Source: Kulakarni S.S et.al., development of nutrient rich noodles by supplementation with malted ragi flour, International Food Research Journal 19(1): 309-313 (2012))

Table:2 Nutritional Information of Jaggery and Sugar

Nutrients (per 100gm)	**Jaggery**	**Sugar**
Carbohydrates (gm)	97.0	99.98
Calcium	40.0	2.0
Iron(gm)	4.0	0.01
Potassium(gm)	1050.0	2.0
Energy (K Cal)	383	387
Magnesium(mg)	70.0	0.0
Phosporus1(mg)	20.0	0.0
Zinc(mg)	0.4	0.02

(Source: Artinci.com)

Coconut ragi biscuits represent a health-oriented bakery product that combines the nutritional strengths of ragi (finger millet) and coconut, both of which are widely recognised for their functional food properties and health benefits. Finger millet is naturally rich in dietary fibre, while desiccated coconut contributes healthy fats and imparts a pleasant tropical flavour to the biscuits. This synergistic combination not only enhances the sensory profile by providing a nutty taste and desirable texture but also offers a wide range of health benefits, including improved digestion, better glycaemic control, and support for bone health.
Biscuits formulated with ragi and coconut are gluten-free, making them suitable for individuals with gluten intolerance and those suffering from coeliac disease. The inclusion of ragi ensures a slow and sustained release of energy, while both ingredients are rich in antioxidants that contribute to cellular protection. Such formulations cater to various age groups, particularly children and elderly individuals, by supporting sustained energy and overall nutritional well-being.
The incorporation of ragi and coconut also supports innovation in functional food product development within the bakery sector. The shelf life of ragi coconut biscuits is approximately one month, which is achieved through the use of food-grade polyethylene packaging. This packaging helps protect the product from moisture absorption, microbial contamination, chemical interactions, and physical damage, thereby maintaining quality and safety during storage.

Objectives of Developing the Product

- To develop nutrient-rich biscuits with enhanced health benefits.
- To replace refined sugar with jaggery as a natural and healthier sweetener.
- To formulate biscuits using whole wheat flour and millets for higher fibre and micronutrient content.
- To analyse the nutritional composition and sensory quality of the developed product.

Materials and Methods

Sampling

Coconut pulp was extracted from mature tender coconuts (Cocos nucifera). The coconut milk was separated from the pulp, and the pulp was subjected to sun drying for two days to remove moisture. After complete drying, the moisture-free pulp was ground into a fine powder and sieved to eliminate impurities and coarse particles. The resulting desiccated coconut powder was then stored and prepared for further use in product formulation.

Formulation of Biscuits

The formulation was designed to obtain well-textured and nutritionally enriched biscuits. Wheat flour and ragi flour were used in a 50:50 ratio with a total flour weight of 1 kg (500 g each). The remaining ingredients were added as per table 3: standardization of composite flour biscuit

Table 3: standardization of composite flour biscuit

Ingredient	Quantity
Wheat flour	500 g
Ragi flour	500 g
Desiccated coconut	300 g
Jaggery powder	500 g
Butter	300 g
Baking powder	12.75 g
Salt	5 g
Vanilla essence	2 ml

This standardized formulation ensured desirable texture, flavour, and improved nutritional quality of the biscuits.

Processing steps for preparation of biscuits:

1. **Preparation of Flours**

Whole wheat flour, ragi flour, and desiccated coconut powder were sieved separately to remove lumps and ensure uniform particle size. This step improved aeration and enhanced dough consistency.

2. **Proportioning the ingredient**

For the preparation of well-textured biscuits, accurate formulation is essential during processing. Wheat flour and ragi flour were used in a 50:50 ratio with a total flour weight of 1 kg (500 g each). The other ingredients included desiccated coconut (300 g), jaggery powder (500 g), salt (5 g), baking powder (12.75 g), butter (300 g), and vanilla essence (2 ml). This precise formulation ensured uniform texture, desirable flavour, and improved nutritional quality of the biscuits.

3. **Mixing and Forming of Biscuits**

The dry ingredients were mixed thoroughly, followed by the addition of liquid ingredients to form a uniform dough. The dough was kneaded until smooth and then rolled to uniform thickness. Biscuit shapes were formed using cutters.

4. Baking and Packaging Process

As per Figure 1, The shaped biscuits were arranged on baking trays and prepared for baking. The oven was preheated to 186°C for 30 minutes, after which the temperature was increased to 200°C. The trays were then placed inside the oven, and the biscuits were baked for 40–50 minutes until complete baking was achieved.

After baking, the trays were removed from the oven and allowed to cool at room temperature showed in Figure 2. Once cooled, the biscuits were packed using A-grade food-grade polythene packaging material. Each packet was then weighed to ensure uniformity in product quantity.

Figure 1: Flow Chart for Preparation of Biscuits

Selection of raw materials
↓
Sieving of wheat flour, ragi flour and desiccated coconut
↓
Weighing and proportioning of ingredients
↓
Creaming of butter and jaggery
↓
Addition of dry ingredients
↓
Mixing to form uniform dough
↓
Kneading and resting of dough
↓
Rolling of dough
↓
Cutting and shaping
↓
Arrangement on baking trays
↓
Preheating of oven (186°C for 30 min)
↓
Baking (200°C for 40–50 min)
↓
Cooling at room temperature
↓
Packaging in food-grade polythene
↓
Weighing and storage

Figure 2: Developed composite flour coconut biscuits in different shapes, topped with chopped nuts, after baking

Figure 2 illustrates the developed composite flour coconut biscuits prepared in assorted shapes such as hearts and stars, showcasing their visual appeal and product uniformity. The biscuits exhibit a light to medium brown colour, indicating adequate baking and desirable Maillard reaction. The surface is garnished with chopped nuts, which are evenly distributed, enhancing both the aesthetic quality and potential nutritional value of the product. The defined edges and consistent thickness of the biscuits reflect good dough handling properties and proper moulding during preparation. Overall, the figure demonstrates the successful development of composite flour coconut biscuits with acceptable physical appearance, texture, and finishing suitable for commercial and sensory evaluation purposes.

Proximate analysis of composite biscuit

To evaluate the quality and nutritional composition of the developed composite biscuits, perform the following proximate and related tests. For accuracy follow standard methods (e.g., AOAC) where possible.

Tests to be performed

1. **Moisture content** — oven drying method (105°C until constant weight (AOAC 32.1.03)).
2. **Crude protein** — Kjeldahl method (determine nitrogen × conversion factor, usually 6.25(AOAC 4.2.09)).
3. **Crude fat** — Soxhlet extraction (petroleum ether).
4. **Ash (total mineral matter)** — muffle furnace (550–600°C until white ash (AOAC 32.1.05)).
5. **Crude fibre** — Acid–base digestion fibre method (AOAC 1990).
6. **Total carbohydrate (by difference)** — 100 − (moisture + protein + fat + ash + fibre).
7. **Energy value (kcal/100 g)** — calculate using Atwater factors:
   Energy = (Protein g × 4) + (Carbohydrate g × 4) + (Fat g × 9).
8. **Mineral analysis** — Ca, Fe, Mg by AOAC method
9. **Sensory evaluation** — 9-point hedonic scale (appearance, colour, texture, taste, overall acceptability).

RESULTS & DISCUSSION

Table 4 Proximate analysis of coconut cookies (control sample)

Parameters	Coconut cookies
Moisture (g)	5.02 ±0.01
Ash(g)	1.60±0.15
Fat(g)	44.27±0.83
Protein(g)	7.83±0.09
Fiber(g)	5.84±0.16
Carbohydrates(g)	35.46±0.81
Energy value (kcal)	571.02±1.00

(Source: Poonam Dhankhar, A Study on Development of Coconut Based Gluten Free Cookies, International Journal of Engineering Science Invention ISSN[Online];2319-6734, ISSN [Print];2319-6726)

Proximate Analysis of Composite Biscuits

The results of the proximate analysis of the developed composite biscuits are presented in Table 5. Values are expressed as mean ± standard deviation per 100 g of product.

Table 5: proximate analysis of the developed composite biscuits

S. No	Parameters	Content / 100 g
1	Moisture (g)	9.594 ± 0.09
2	Protein (g)	9.46 ± 0.13
3	Fat (g)	1.327 ± 0.07
4	Minerals (g)	8.33 ± 0.12
5	Crude fibre (g)	3.61 ± 0.07
6	Carbohydrates (g)	73.63 ± 0.93
7	Energy (kcal)	344.22 ± 1.12

The results indicate that the composite biscuits possess a low moisture content, which is favourable for enhanced shelf life and microbial stability. The protein content reflects the nutritional contribution of whole wheat and ragi flours, while the low-fat content makes the product suitable for health-conscious consumers. The relatively high carbohydrate level confirms its role as a good energy source.

The presence of crude fibre and minerals further enhances the functional and nutritional value of the biscuits, supporting digestive health and contributing to essential micronutrient intake. The calculated energy value of 344.22 kcal per 100 g indicates that the product is nutritionally dense and suitable as a supplementary snack.

Micronutrient Composition of Composite Biscuits:

The micronutrient profile of the developed composite biscuits is presented in the table 6. Values are expressed as mean ± standard deviation per 100 g of product.

Table 6: Micronutrient profile of the developed composite biscuits

S. No	Parameters	Content / 100 g
1	Vitamin E (mg)	29.27 ± 0.42
2	Vitamin B3 (mg)	2.74 ± 0.39
3	Iron (mg)	14.74 ± 0.40
4	Calcium (mg)	149.79 ± 0.49
5	Phosphorus (mg)	296.00 ± 0.69

The results indicate that the composite biscuits are rich in essential micronutrients. The high Vitamin E content enhances antioxidant potential, while Vitamin B3 supports energy metabolism and overall cellular function. The iron content suggests that the biscuits may aid in improving haemoglobin levels and preventing iron deficiency. The presence of substantial calcium and phosphorus contributes to bone health and proper mineralization.

Overall, the micro nutrient enhancement observed in these biscuits can be attributed to the inclusion of ragi, whole wheat flour, coconut, and jaggery, making the product nutritionally superior compared to conventional refined biscuits and suitable as a functional snack option.By comparing table 4 and table 5,6 the composite flour coconut biscuits are analyzed to be nutrient rich and favors health benefits

Nutritional Composition

The nutritional composition of the developed composite biscuits was determined through proximate and mineral analysis. The results revealed that the biscuits contained moisture (9.5 ± 0.09%), protein (9.466 ± 0.13%), ash (9.0 ± 0.56%), carbohydrates (73.0 ± 0.93%), and fat (1.3 ± 0.07%). The relatively low moisture content indicates a longer shelf life and good storage stability, while the moderate protein content reflects the contribution of whole wheat and ragi flours.

The total mineral content was found to be 8.33 ± 0.12%. Among the individual minerals, calcium content was 149 ± 0.45 mg/100 g, phosphorus was 296 ± 0.69 mg/100 g, and iron was 14 ± 0.40 mg/100 g, demonstrating the mineral-rich nature of the biscuits owing to the inclusion of ragi and desiccated coconut. These values suggest that the product can contribute significantly to daily micro nutrient requirements, particularly calcium and iron.

Vitamin analysis showed appreciable levels of Vitamin E (29.275 ± 0.42 mg/100 g) and Vitamin B3 (2.75 ± 0.39 mg/100 g), further enhancing the functional value of the product. The total energy value of the biscuits was calculated as 344 kcal per 100 g, indicating that the product is energy-dense while still maintaining improved nutritional quality.

Overall, the results confirm that the composite biscuits formulated with whole wheat, ragi, coconut, and jaggery possess enhanced nutritional properties compared to conventional refined biscuits, making them a healthier alternative suitable for regular consumption.

Figure 3: Nutritive comparison of composite flour biscuits and coconut cookies

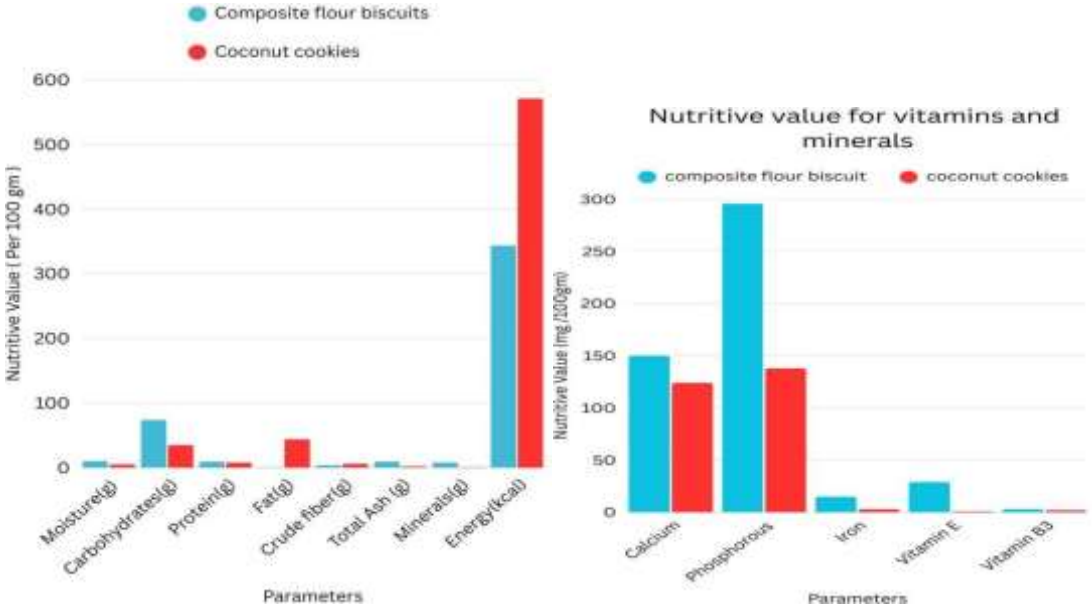
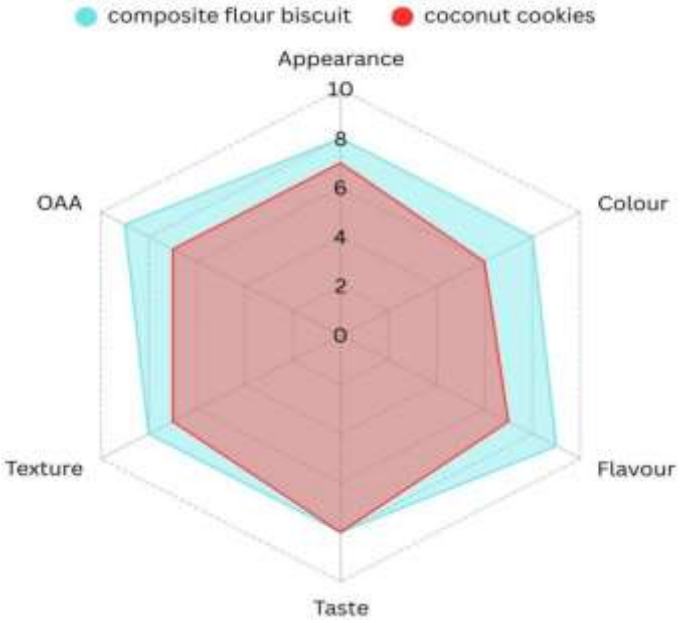


Figure 4: Sensory Evaluation Using 9-Point Hedonic Scale (Spider Graph)



The spider graph Figure 4: illustrates the sensory evaluation scores of composite flour biscuits and coconut cookies based on a 9-point hedonic scale for key attributes such as Appearance, Colour, Flavour, Taste, Texture, and Overall Acceptability (OAA).

The composite flour biscuits received consistently higher scores across most attributes when compared to coconut cookies. Appearance and colour scores were notably higher, indicating better visual appeal and consumer preference. Flavour and texture also scored superior in composite biscuits, reflecting a more pleasant mouthfeel and balanced formulation due to the incorporation of whole wheat, ragi, coconut, and jaggery.

Both products showed similar scores for taste, suggesting that coconut cookies remain acceptable in palatability; however, the composite biscuits achieved a higher score for overall acceptability (OAA), confirming their better consumer preference.

The spider graph clearly demonstrates that the composite flour biscuits exhibited improved sensory quality, especially in terms of appearance, flavour, texture, and overall acceptability, indicating their suitability as a more appealing and nutritionally enhanced product compared to conventional coconut cookies.

DISCUSSION

Comparative Nutritive Value of Composite Flour Biscuits and Coconut Cookies

The comparative graphical representation illustrates significant differences in the nutritional profile of composite flour biscuits and coconut cookies, both in terms of proximate composition and micronutrient content. By comparing table 4 and table 5 the nutritive content of composite flour coconut biscuits are rich in nutrients.

Proximate Composition

The composite flour biscuits exhibited **higher carbohydrate (73.63 g/100 g)** and **protein (9.46 g/100 g)** levels compared to coconut cookies, indicating their superior role as a source of sustained energy and body-building nutrients. Additionally, the **crude fibre content (3.61 g/100 g)** was notably higher in composite biscuits, which contributes to improved digestive health and better metabolic function.

In contrast, coconut cookies showed markedly higher **fat** and **energy values**, making them more calorie dense. While this may enhance palatability, it also makes them less suitable for regular consumption by health-conscious individuals. The moisture content was slightly higher in coconut cookies, which may negatively influence shelf life when compared to the composite biscuits.

Overall, the lower fat and higher fibre content of composite biscuits highlights their suitability as a healthier alternative snack option.

Vitamins and Minerals

The composite flour biscuits demonstrated significantly higher levels of essential micronutrients. **Calcium (149.79 mg/100 g)** and **phosphorus (296 mg/100 g)** were considerably higher than those in coconut cookies, indicating strong potential in supporting bone health and skeletal development.

Iron content was also higher in composite biscuits, suggesting their role in preventing iron-deficiency anaemia. Furthermore, the presence of **Vitamin E (29.27 mg/100 g)** and **Vitamin B3 (2.74 mg/100 g)** indicates enhanced antioxidant activity and support for energy metabolism.

Overall Interpretation

The graphical comparison clearly demonstrates that **composite flour biscuits fortified with ragi, wheat, coconut, and jaggery possess superior nutritional quality** compared to conventional coconut cookies. The improved protein, fibre, mineral, and vitamin content, coupled with lower fat and caloric density, makes them a more balanced and health-promoting functional food.

Conclusion

The study confirms that composite flour biscuits offer enhanced nutritive value and can be recommended as a healthier alternative to traditional coconut cookies, especially for individuals seeking nutritious snack options with better dietary benefits.

REFERENCES

1. AOAC. (1995). Official Methods of Analysis (17th ed.). Association of Official Analytical Chemists, Washington DC, USA.
2. Bhattacharyya, A., & Bhattacharyya, N. (2002). Coconut in nutrition. Indian Journal of Nutrition and Dietetics, 39, 132–142.
3. El-Sharnouby, G., Aleid, S., & Al-Otaibi, M. (2012). Nutritional quality of biscuit supplemented with wheat bran and date palm fruits (Phoenix dactylifera L.). Food and Nutrition Sciences, 3(3), 322–328.
4. Falade, K. O., & Akingbala, J. O. (2009). Improved nutrition and national development through the utilization of cassava in baked foods. In G. L. Robertson & J. R. Lupien (Eds.), Using Food Science and Technology to Improve Nutrition and Promote National Development (pp. 1–12).
5. Fox, B. A., & Cameron, A. G. (1999). Food Science, Nutrition and Health (6th ed.). Edward Arnold Publisher, London, UK, pp. 175–179.
6. Gopalan, C., Sastri, R. B. V., & Balasubramanian, S. C. (2002). Nutritive Value of Indian Foods. National Institute of Nutrition, ICMR, Hyderabad, India.
7. Goyat, A., Singh, N., & Shalini. (2016). Prominent features to increase the shelf life of a product line. International Journal for Technological Research in Engineering, 3(10), 3103–3107.
8. Ho, L. H., & Nadratul Wahidah, A. L. (2016). Nutritional composition, physical properties and sensory evaluation of cookies prepared from wheat flour and pitaya (Hylocereus undatus) peel flour blends. Cogent Food & Agriculture, 2(1), 1136369.
9. Howeler, R. H. (2004). Cassava in Asia: Present situation and its future potential in agro-industry. In Centro Internacional de Agricultura Tropical (CIAT). Bangkok: Cassava Office for Asia.
10. International Journal of Engineering Science Invention ISSN [online]2319-6734; ISSN[Print]2319-6726 A Study on Development of Coconut Based Gluten Free Cookies Poonam Dhankhar,M.Tech
11. Kim, E. H., Corrigan, V. K., Wilson, A. J., Waters, I. R., Hedderley, D. I., & Morgenstern, M. P. (2011). Fundamental fracture properties associated with sensory hardness of brittle solid foods. Journal of Texture Studies, 45(1), 49–62.
12. Lal, J. J., Kumar, C. V. S., & Indira, M. (2003). Coconut palm. In B. Caballero (Ed.), Encyclopedia of Food Sciences and Nutrition (2nd ed., pp. 1464–1475). Academic Press.
13. Lu, R. (2013). Principles of solid food texture analysis. In D. Kilcast (Ed.), Instrumental Assessment of Food Sensory Quality (pp. 103–128). Woodhead Publishing.
14. Misra, N. N., & Tiwari, B. K. (2014). Biscuits. In W. Zhou (Ed.), Bakery Products Science and Technology (2nd ed.). Wiley-Blackwell.
15. Nitisewojo, P. (1995). Prinsip Analisis Makanan. Bangi: Penerbit Universiti Kebangsaan Malaysia.
16. Noorfarahzilah, M., Lee, J. S., Sharifudin, M. S., Mohd Fadzelly, A. B., & Hasmadi, M. (2014). Applications of composite flour in development of food products. International Food Research Journal, 21(6), 2061–2074.
17. Oluwamukomi, M. O., Oluwalana, I. B., & Akinbowale, O. F. (2010). Physicochemical and sensory properties of wheat-cassava composite biscuit enriched with soy flour. African Journal of Food Science, 5(2), 50–56.