

Adlay (*Coix lacryma-jobi* L.) Nutrimeals: Proximate Composition and Nutrition Facts

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Abstract: Adlay (*Coix lacryma-jobi* L.) is known as a 'one-stop' crop as source of energy and protein for all ages. Its grits and flour can be processed into different kinds of nutrimeals. Chemical analysis revealed that geelay (arrozcaldo) had the highest moisture content with least fat. Cookies had the highest amount of fat, protein, ash and sodium. On a per serving basis, champorado had the highest calories of 260/200g, followed by chocolate cake with 230 calories/70g or single slice. Fat content was higher in chocolate cake and ice cream while more sodium in geelay (arrozcaldo) than the rest of the nutrimeals. The champorado had the highest total carbohydrate content (50g/200g) and the highest protein content of 7g/200g serving. Yet, ice cream had the least sodium and protein content. These nutrimeals are rich in energy and protein which are potential complementary and supplementary food to undernourished infants and preschool children.

Keywords: Adlay (*Coix lacryma-jobi* L.), Nutrimeals, Chemical Analysis, Nutrition facts

1. INTRODUCTION

Adlay (*Coix lacryma-jobi* L.) is considered the king of all grasses, to which the major cereals like rice and corn belong. This is due to its nutritional value aside from its health benefits such as anti-diabetic [1]; [2]; anti-cancer ([3]; [4]; [5] [6], anti-leukemia [7] and with gastro-protective properties [8]. It is considered a healthy grain for human consumption [9]; [10].

Filipino farmers reported that adlay has good eating quality and the grains can be pounded and cooked just like rice. It is a promising crop in the Philippines as a potential food source. Its grits can be cooked like rice, and the flour can be made into favorite delicacies such as 'maja blanca', 'sinukmani', 'polvoron', 'turones de adlay', and other rice-based foodies. Aside from that, adlay flour can be made into bread, pasta and porridge. Its grains are processed into 'tapoy' wine and the roasted grits are made into coffee or tea [10]. Aside from its uses as food, several studies indicate that adlay is anti-allergenic, anti-mutagenic, hypolipemic and with anti-diabetic effects. The adlay bran is used in traditional Chinese medicine as antidote to dysmenorrhea and is thus considered as a therapeutic agent [12].

The Food and Nutrition Research Institute (FNRI) reported that adlay grits contain 12.8g protein, 0.3g total dietary fiber, 73.9g total carbohydrates, 1.0g total fat, 0.2g ash, 356 kcal energy and 12.1g moisture. Similarly, adlay flour has 12.33% protein, 0.42% ash, 1.75±0.16% crude protein, 13.96% crude protein, 1.26% crude fat, 83.61% carbohydrates and 397.62 calories per 100g [11]. Likewise, cooked adlay grits contain 76.2g moisture, 0.1g ash, 96.0 kcal energy, 0.3g total fat, 18.7g total carbohydrates, 3.7g protein and absence of total dietary fiber [13].

Food and nutrition security have been the major concern of developing countries worldwide. Under-nutrition had been seen to be associated with 2.7 million child deaths annually or 45% of all child deaths. Feeding infant and young children play a vital role in improving child survival as well as promote proper well-being, that is healthy growth and development. Accordingly, infants about 6 months old need for energy and nutrients aside from those obtained from breast milk. Complementary and supplementary foods are necessary to meet their energy and protein needs. These foods must be introduced to them otherwise their growth may be affected [14].

Protein-energy malnutrition (PEM) and micronutrient deficiencies remain the leading nutritional problems in the Philippines. The general declining trend in the prevalence of underweight, wasting and stunting among Filipino children noted in the past 10 years was countered with the increase in the prevalence rate in 1998. About 4 million (31.8%) of the preschool population were found to be underweight-for-age, 3 million (19.8%) adolescents and 5 million (13.2%) adults, including older persons were found to be underweight and chronically energy deficient, respectively [15].

Malnutrition in the country is caused by interrelated factors such as health, physical, social, economic and others. This was brought about by food insecurity and poverty which have consequent impact on nutritional status. Typical Filipino diet was found to be grossly inadequate for energy, protein and other nutrients [15]

With this scenario, the Philippine government sought to address food insecurity and health among infants and pre-schoolers. Adlay had been claimed in previous studies to be a health and wellness crop, energy-and protein-rich. Thus, its grits and flour had been prepared into nutrimeals as supplementary food to preschoolers who were categorized as underweights, with energy and protein deficiency in their diets. Prior to introduction of nutrimeals to recipient undernourished children, these were subjected to chemical and nutritional analyses at the Regional Standards and Testing Laboratory (RSTL) of the Department of Science and Technology (DOST) in Davao City, Philippines.

2. MATERIALS AND METHODS

2.1. Source of Adlay Grits

Adlay grits that were processed into nutrimeals were sourced out from the DA-BAR Adlay Research and Development Project and the CMU-CHED NAFES Adlay Project. The adlay grits was processed into flour from a nearby market while the other ingredients such as brown and white sugar, milk, eggs, baking powder, butter, powdered milk, vanilla, evaporated milk, condensed milk sweetened cocoa powder, cheese, all-purpose cream, desiccated coconut, raisins, vegetables and spices were obtained from the department store in Valencia City, Bukidnon, Philippines.

2.2. Preparation of Nutrimeal Samples

All tools and equipment used for every process were cleaned and sanitized before using. Freshness and condition of each ingredient were made sure it is of great quality.

2.2.1 Cookies

The oven was pre-heated at 350° Fahrenheit. Baking sheets were lined with wax paper or brushed with vegetable oil before use. In a mixing bowl, refined sugar and butter were creamed together; eggs and vanilla were then added and mixed. In a separate mixing bowl, adlay flour, powdered milk and baking powder were mixed until thoroughly blended. Mixture of dry ingredients were then poured to the creamed ingredients and mixed. After which, a spoonful of the mixture was scooped and placed into the prepared baking sheets and baked for 3-5 minutes then allowed to cool before serving or wrapped individually in water cellophane.

2.2.2 Geelay or Arrozcaldo (Adlay-Vegetable Porridge)

Adlay grits were cleaned from inert materials and soaked overnight. After which, water was drained and the pre-soaked grits were placed in the kettle, added with water and cooked while continuously stirring. Since adlay requires more water to cook compared to other cereals, like rice, water is added if necessary until desired consistency of the porridge. Meanwhile, chicken meat, preferably breast part, was blanched and diced. Carrots, squash and chayote were cut into cubes. At the same time, bulb onions, spring onions, ginger and garlic were prepared. Cooking pot was heated and added with a spoonful of oil. Spices were sauteed, before adding chicken meat and vegetables. The pre-cooked adlay grits was then added, seasoned with salt and seasoning to have good taste and flavor. It was brought to boil for a bit and removed from fire, cooled for a bit, then served.

2.2.3 Champorado (Choco-flavored Adlay Porridge)

Adlay grits were prepared and cooked the same way as the preparation for Geelay or Arrozcaldo. Cocoa powder, refined sugar, evaporated milk and vanilla was then added to give good taste and flavor to the food product.

2.2.4 Chocolate Cake

The oven was pre-heated and set at 350 degrees. Baking pans were lined with wax paper in preparation for baking. In a mixing bowl, refined sugar and butter were creamed together; eggs and evaporated milk were then added and mixed. Adlay flour, cocoa and baking powder were then added and mixed thoroughly with the liquid ingredients. The batter mixture was then poured into the baking tin. This was baked for 30-40 minutes in the pre-heated oven. When done, the cake was allowed to cook before serving.

2.2.5 Ice Cream

In the cooking pot, adlay flour was added with enough water and cooked over low flame while continuously stirring, until sticky, porridge-like consistency was achieved. It was cooled down before adding other ingredients. Then in a mixing bowl, pre-cooled all-purpose cream was beaten using an electric mixer/blender until frothy and soft peak. Cooked adlay, evaporated milk, refined sugar and vanilla were slowly added while continuously beating. Mixture was then poured into individual plastic cups with cover and frozen for six hours before serving.

2.3 Submission of Nutrimeal Samples for Chemical and Nutrifacts Analyses

One kilogram each of the prepared nutrimeals was placed in separate containers, cooled and labeled before submission to the Regional Standards and Testing Laboratory (RSTL) of the Department of Science and Technology (DOST) in Davao City, Philippines.

2.4 Methods of Preparation

The preparation of the different samples for chemical and nutrient analyses were done by the technical expert from the Regional Standards and Testing Laboratory (RSTL) of the Department of Science and Technology (DOST) in Davao City, Philippines. The moisture content was obtained through Air-oven Method; crude fat analysis by Soxhlet Extraction; crude protein by Kjeldahl Method; ash analysis by Gravimetric Method and the minerals in food was by Atomic Absorption Spectroscopy (AAS).

2.5 Proximate Analysis

The sample food products were subjected to chemical analysis to determine the following: moisture content, fat, protein, ash and sodium contents. Likewise, the same nutrimeals were analyzed for nutrient contents per serving size. The data taken include: calories, calories from fat, total fat (g) and daily value (%), sodium (mg) and daily value (%), total carbohydrate (g) and daily value (%) and protein (g) content following the standard procedures of the Department of Science and Technology (DOST)-Region XI, Davao City, Philippines.

3. RESULTS AND DISCUSSION

1. Chemical Analysis

Table 1 shows the chemical analysis of the different adlay nutrimeals, namely: Cookies, geelay (arrozcaldo), champorado, chocolate cake and ice cream that were used for the supplementary feeding of underweight preschoolers in the City of Valencia, Bukidnon, Philippines.

Among the nutrimeals, geelay (arrozcaldo) had more moisture (85.26%), followed by champorado (69.34%). Cookies had the least moisture content among the nutrimeals (5.88%). As to fat content, geelay (arrozcaldo) and champorado had the least amount of fat with 0.82% and 1.43%, respectively and cookies had the highest fat content (15.45%). In terms of protein content, cookies had the highest amount of protein of 9.24% per serving, followed by chocolate cake (8.67%), champorado or (3.63%), and geelay (arrozcaldo) (2.14%). Ice cream had a very small amount of protein per serving with only 1.33%. These food products have traceable amounts of ash ranging from 0.27% (ice cream) to 1.8% (cookies). Moreover, said nutrimeals also contain few amounts of sodium which range from 15mg/100g (champorado) to 487mg/100g (cookies).

Table 1. Chemical Analysis of Adlay Nutrimeals, DOST-XI, Davao City, Philippines

Adlay Nutrimeals	Moisture ^a	Fat ^b	Protein ^c	Ash ^d	Sodium ^e
Cookies	5.88%	15.45%	9.24%	2.8%	487mg/100g
Geelay (Arrozcaldo)	85.26%	0.82%	2.14%	0.98%	235mg/100g
Champorado	69.34%	1.43%	3.63%	0.47%	15mg/100g
Chocolate Cake	30.96%	11.66%	8.67%	1.39%	230mg/100g
Ice Cream	59.68%	10.17%	1.33%	0.27%	17mg/100g

^aMoisture Analysis by Air Oven Method

^bCrude Fat Analysis by Soxhlet Extraction

^cCrude Protein by Kjeldahl Method

^dAsh Analysis by Gravimetric Method

^eMinerals in Food by AAS

2. Nutrifacts Analysis

The five nutrimeals were also subjected to nutrition facts analysis (Table 2). The champorado (200g/serving) had the highest amount calories of 260, followed by chocolate cake with 230 calories while geelay (arrozcaldo) had the lowest with 120 calories only. Chocolate cake had the highest calories from fat with 70 (8g) followed by ice cream with 60 calories (7g) per serving. On the other hand, geelay (arrozcaldo) had the highest content of sodium with 490mg while ice cream had the least amount of sodium with 10mg. For total carbohydrate content per serving, champorado had the highest content of 50g per serving with chocolate cake next with 33g. All other types of nutrimeals have more or less the same carbohydrate contents. As to protein content per serving, among the nutrimeals, champorado had the highest content of 7g/200g, followed by chocolate cake (6g/slice), geelay (arrozcaldo) (4g/200g), and cookies with 3g (30g/serving). But Ice cream had the smallest amount of protein per serving (70g) of less than 1g. In comparison, chocolate rice pudding only contains 110 kcal/serving (99g) and 1g protein, 2.5g total fat, 120mg sodium, 120mg potassium and 21g total carbohydrates [16].

Table 2. Nutrition Facts of Adlay Nutrimeals, DOST-Region XI, Davao City, Philippines

Nutrifacts	Serving Size	Calories	Calories from Fat	Total Fat, g	Daily Value, %	Na, mg	Daily Value, %	Total Carb, g	Daily Value, %	Protein, g
Cookies	30 g (5 pcs)	130	40	4.5	7	150	6	20	7	3
Geelay (Arrozcalo)	200g (1 cup)	120	15	1.5	3	470	20	22	7	4
Champorado	200g (1 cup)	260	25	3	4	30	1	50	17	7
Chocolate Cake	70g (1 slice)	230	70	8	13	160	7	33	11	6
Ice Cream	70g (1 cup)	150	60	7	11	10	0	20	7	< 1

CONCLUSION

Adlay nutrimeals are rich in energy and protein which are potential complementary and supplementary food to infants and preschool children. Chemical analysis revealed that geelay (arrozcaldo) had the highest moisture content with least fat. Cookies had the highest amount of fat, protein, ash and sodium. Moreover, among the nutrimeals, on a per serving basis, champorado had the highest calories 260 per 200g, followed by chocolate cake with 230 calories per 70g or single slice. Fat content was also more in chocolate cake and ice cream. However, there was more sodium in geelay (arrozcaldo) than other kinds of nutrimeals. On the other hand, champorado had the highest total carbohydrate content (50g/200g) as well as the highest protein content of 7g/200g serving. Among the nutrimeals, ice cream had the least amount of sodium and protein content.

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