

Nutritional Composition of Dikiri Coconut

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Abstract

Dikiri, an abnormal type of coconut found mainly in the southern part of Sri Lanka, was analyzed for its proximate composition, dietary fiber, minerals, vitamin C and fatty acid profile. Pectin was isolated and characterized (moisture, ash, acetyl value, methoxyl value, equivalent value) from dikiri coconut. Dikiri coconut contains $38.91 \pm 0.9\%$, $2.95 \pm 0.2\%$, $58.21 \pm 3.6\%$, $17.62 \pm 0.2\%$, $6.63 \pm 0.3\%$ and 14.59% dry matter, ash, crude fat, crude fibre and carbohydrate respectively. The main dietary fiber components of Dikiri coconut were pectin and hemicellulose while that of normal coconut was cellulose. Lignin content was significantly lower in the kernel of dikiri coconut (3.98 ± 0.9) than normal coconut kernel ($6.14 \pm 0.7\%$). Equivalent weight, methoxyl value, moisture, ash and acetyl value of dikiri pectin were 1052.7 ± 11.08 , 8.72 ± 0.25 , 85.8 ± 1.65 , 0.8 ± 0.04 and 0.09 ± 0.01 respectively. The main mineral found in dikiri was potassium. Vitamin C content of dikiri coconut was $2.32 \text{ mg}/100\text{g}$. The fatty acids composition of dikiri was similar to normal coconut and saturated fatty acids constituted nearly 90% of total fatty acids and lauric acid is the main fatty acid followed by myristic acid.

Keywords: Dikiri, proximate composition, dietary fiber, fatty acids, pectin characterization.

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Introduction

Dikiri is an abnormal coconut variety, concentrated in down south areas of Sri Lanka and the special feature of this coconut variety is the soft gelatinous amorphous kernel. Due to its abnormal nature, embryo cannot grow and develop in to a normal seedling. In Sri Lanka, Coconut Research Institute (CRI) use the embryo culture technology for mass production of dikiri palm (Vidanaarachchi, *et.al*, 1997). Similar abnormal coconut types are also reported in other coconut growing counties. 'Makapuno' in Philippines, 'Kelapa Kopyor' in Indonesia and 'Thairu Thengai' or 'curd coconut' in India are some peculiar form of coconut varieties. This abnormal nature is governed by a single recessive allele (Hastijaro, 1989 cited in Santoso et al, 1996). In Sri Lanka dikiri is consumed as fresh or with jaggary, and also these nuts are sold to foreigners at higher prices. But there are no value added products available in the market.

According to Aracon (1996), In Philippines Makapuno is used to produce wide variety of food items such as ready to serve succulent jam, bread spread, filling for pies and tarts and ice cream are the major products from Makapuno. Ice cream made with this abnormal coconut in Philippines is considered as one of the best flavoured ice cream. In Philippines there is a huge demand gap for Makapuno. So, Dikiri coconut can be considered as high potential ingredients in coconut sector. However, no report is available on the nutritional constituents of dikiri coconut. The present work was therefore undertaken with the purpose of analyzing the proximate composition, fatty acids profile, dietary fiber and mineral composition of dikiri coconut and compared with normal mature coconut.

Materials and methods

Materials

Twenty five Dikiri coconuts with same maturity (11 months) were obtained from well maintained home garden in Weligama, Southern

Province of Sri Lanka and from which six nuts were randomly selected for the chemical analysis. Twenty five same maturity (11 months) normal coconuts (Sri Lankan Tall) were collected from the same harvest of Bandirippuwa Estate of Coconut Research Institute, Sri Lanka and six nuts were randomly selected and used as sample nuts. For the pectin extraction pumpkin, wood apple, passion fruits and apple were purchased from local market in Dankotuwa, Sri Lanka. Food grade pectin was purchased from local chemical supplier in Sri Lanka.

Preparation of sample

The nuts were dehusked and split using a knife. The white kernels were scooped by a stainless steel spoon without scraping off the brown testa with the kernel and cut into small pieces using a stainless steel knife. Dikiri and normal coconut samples were placed in the Gallenkamp plus 2 electric oven separately at 105°C until a constant weight is observed. The dried samples were packed in ploythene bags and stored in a refrigerator for the chemical analysis.

Proximate composition

Moisture, protein, lipid, ash and crude fiber contents were determined following the standard methods of the Association of Official Analytical Chemists (1990). Total Carbohydrate content was calculated from the difference. All samples were analyzed at least in triplicate.

Mineral and vitamin C analysis

The defatted Dikiri and normal coconut samples were subjected to dry ashing procedure. Na, K, Ca, and Mg concentrations were determined by atomic absorption spectrophotometer (G.B.C. 904 AA). All the sample analysis was carried out as triplicates. Vitamin C (total ascorbic acid level) was analyzed using 2,6 Dichloro Indophenol Visual Titration Method described in Ranganna, 2000.

Analysis of Fatty Acids

Fatty acids were transformed to their methyl esters (FAME) following the method of Hartman & Lago (1973) and were determined by using a gas chromatograph (GC) HP 5890 Series II (Hewlett-Packard, Palo-Alto, CA, USA) equipped with a flame ionization detector. FAME sample (1.5 mL) was injected and GC separation was carried out on an HP-INNO wax capillary column (Hewlett-Packard; 30 m length, 0.25 mm i.d. and 0.25 μ m film thickness). The carrier gas (helium) head pressure was maintained at 11.5 psi and the column flow rate was 1 mL min⁻¹. The oven temperature was held initially at 120^o C for 1 min, increased from 120^o C at 8^o C min⁻¹ to 210^o C and then maintained at 210^o C for 45 min. The temperatures of the injection port and of detector were 250 and 280^o C, respectively. FAME were positively identified by matching their retention time data and mass spectra with those of the authentic standards obtained from various firms (Nu-Chek-Prep; Sigma, St Louis, MO, USA) which were also run under identical analytical conditions using a high resolution GC-MS system (GCQ of Finnigan Mat).

Analysis of Dietary Fiber

Acid detergent fiber (ADF), neutral detergent fiber (NDF) and lignin contents were determined based on the method described by Van Soest (1973). According to the McAllen, (1985) the difference between NDF and ADF is used for the presumptive estimation of hemicelluloses; the difference between ADF and lignin content is used for the presumptive estimation of cellulose.

Extraction of Pectin

Pectin from Dikiri was extracted using the method described in Ranganna(2000). Similarly, pectin was extracted from pumpkin, passion fruit peel, apple rind and wood apple. The dry weights of extracted pectin was compared with Dikiri pectin.

Characterization of Pectin

Moisture, ash percentage, equivalent weight, methoxyl value and acetyl values of Dikiri pectin and commercial pectin were determined using methods described by Ranganna(2000).

Statistical Analysis

The data were analysed and the means and SD were obtained. Mean comparison was done using analysis of variance and independent sample t-test using SPCC 10 Statistical package (SPSS, Inc. Chicago, IL).

Results and Discussion

Proximate Composition

The proximate composition of Dikiri coconut and normal coconut samples are shown in Table 1. There was a significant difference ($p < 0.05$) in drymatter and crude fibre between Dikiri and ordinary coconut variety. Normal coconut ($44.7 \pm 0.3\%$) showed significantly higher amount of dry matter compared to dikiri coconut kernel ($38.91 \pm 0.9\%$) indicating high moisture level in Dikiri coconut kernel compared to normal coconut. Dikiri coconut contains high amount of fiber ($17.62 \pm 0.2\%$) than that of normal coconut ($16.30 \pm 0.2\%$). Crude fat content of the both dikiri ($58.21 \pm 3.6\%$) and normal coconut ($60.69 \pm 6.6\%$) samples were more or less similar. However, fat content of dikiri coconut is much deviated to that of Kopyor coconut, which is a abnormal coconut variety in Indonesia containing 30.71% fat on dry weight basis (Santoso et.al, 1996). Protein, ash and carbohydrate content of Dikiri coconut were 6.63 ± 0.3 , 2.95 ± 0.2 and 14.59 respectively and were similar to normal coconut kernel.

Table 1. Proximate composition of Dikiri and normal coconut kernel

Constituent	Dikiri	Normal
Dry matter %	38.91 ± 0.9	44.7 ± 0.3
Ash % (db)	2.95 ± 0.2	2.81 ± 0.1
Crude fat % (db)	58.21 ± 3.6	60.69 ± 6.6
Crude fibre % (db)	17.62 ± 0.2	16.30 ± 0.2
Crude protein % (db)	6.63 ± 0.3	6.80 ± 0.2
Carbohydrate (db)	14.59	13.40

db-dry weight basis

Table 2. Fiber composition of Dikiri and normal coconut

Components (% of db)	Dikiri Coconut	Normal Coconut
ADF (Acid detergent fiber) %	11.01 ± 0.4	13.78 ± 0.6
NDF (Neutral detergent fiber) %	28.39 ± 0.7	21.51 ± 0.5
Lignin %	3.98 ± 0.9	6.14 ± 0.7
Hemicelluloses %	17.38	7.73
Cellulose %	7.03	7.64
Pectin	22.36 ± 1.2	0.12 ± 0.01

Fiber composition:

According to the definition by the American Association of Cereal Chemists (cited in Bunzel, et.al.,2006), dietary fiber is the edible part of plants or analogous carbohydrates that are resistant to digestion and absorption in the small intestine with complete or partial fermentation in the large intestine. Dietary fiber includes polysaccharides, oligosaccharides, lignin and associated plant substances. Dietary fiber composition of dikiri coconut and normal coconuts are shown in the Table 2. The main dietary fiber components of Dikiri coconut were pectin and hemicelluloses while that of normal coconut was cellulose. Similar trends were obtained for kopyor coconut (Santoso, *et.al.*, 1996) and for makapuno coconut (Rosario *et.al.*, 1980). Lignin content was significantly higher in the kernel of normal coconut than dikiri coconut kernel. lignin are usually found in secondary cell walls of plants and that are hard and impart strength to the structure of the cell wall (Terashima *et.al.*1995). High amount of hemicellulose and low amount of lignin in the

dikiri coconut kernel may responsible for soft nature of its kernel.

Pectin Content:

The extractable pectin yields from coconuts and other fruits sources are shown in Figure 1. This shows that dikiri contains considerably high amount of pectin (22.36 ± 1.2%) compared to other commercial pectin sources. According to the studies done by Rosario and Gabuya, (1980), makapuno contains about 31.5% pectin (dry weight basis) which is six times higher than that in normal coconut (5.9%). However, present studies have found normal coconut has negligible amount of pectin. This may be due to use of different extraction methods.

The physico chemical properties of dikiri pectin and commercial fruit grade pectin were compared in Table 3. Some of the physico chemical properties, such as equivalent weight and methoxyl value of dikiri pectin are comparable with that of commercial pectin. The moisture content, ash percentage and

Figure 1. Pectin yield from Dikiri and other available sources

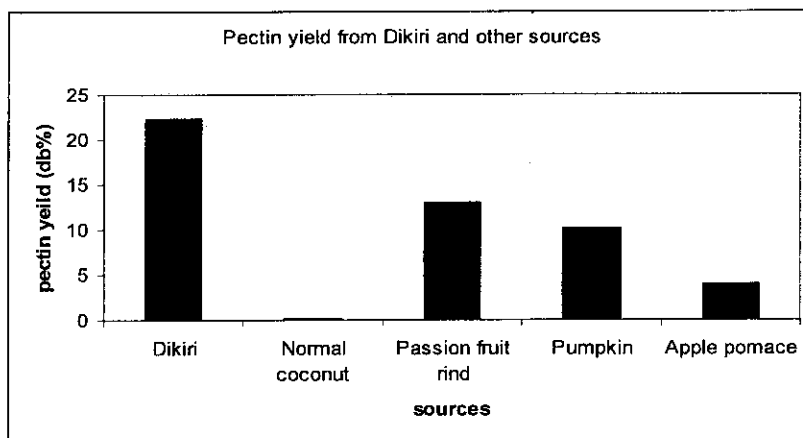


Table 3. Characterization of pectin from Dikiri and commercial pectin

	Dikiri pectin % (db)	Commercial pectin % (db)
Moisture	85.8 ± 1.65	87.2 ± 0.17
Ash	0.8 ± 0.04	0.9 ± 0.1
Equivalent weight	1052.7 ± 11.08	642.6 ± 14.55
Methoxyl value	8.72 ± 0.25	7.36 ± 0.12
Acetyl value	0.09 ± 0.01	0.05 ± 0.01

acetyl value of dikiri pectin are not significantly different ($p > 0.05$) to those of commercial pectin. The equivalent weight of dikiri is significantly high (1052.71) than the commercial pectin (642.61). Dikiri pectin contains about 0.8% ash and low amount of ash is favourable for gel formation.

The carboxylic groups of galacturonic acid are methylated and this percentage of esterification is defined as the Methoxyl value or degree of esterification. This is an important factor for controlling setting time, gelation and solubility. Dikiri pectin shows 8.72 methoxyl values to make it high Methoxyl pectin. The high Methoxyl pectin requires high amount of sugar and acid to initiate gel formation. (Hoejgarrd, 2005). During extraction due to low

pH, pectin can be de-esterified to produce low Methoxyl pectin. Acetyl group inhibits gel formation of pectin. Sugar beet pectin contains high amount of acetyl groups (Ranganna, 2000). Dikiri pectin contains low amount of acetyl groups which is favourable for gel formation. Studies on characterization of pectin will give invaluable information about the potential use of dikiri coconut in food industry.

Mineral Content

The mineral composition of dikiri and normal coconut kernel is shown in Table 4. Mineral composition of dikiri coconut was comparable with that found in normal coconut and potassium is the chief mineral. The vitamin C content (2.32 mg/100g) also comparable with that of normal mature coconut (2.10mg/100g). These findings support the

Table 4. Na, K, Ca and Mg composition of Dikiri kernel with compared to normal Coconut (Sri Lankan Tall)

Element	Dikiri % (db)	Normal % (db)
Na	0.15 ± 0.02	0.11 ± 0.002
K	2.38 ± 0.04	2.11 ± 0.04
Ca	0.023 ± 0.0014	0.06 ± 0.007
Mg	0.36 ± 0.009	0.42 ± 0.053
Vit.C	2.32 mg/100g	2.10mg/100g

Table 5. Fatty acids composition of dikiri and normal coconut varieties

Fatty acids	Dikiri coconut	DXT hybrid	Sri Lankan Tall
C6 Caproic	0.45	1.03	1.81
C8 Caprilic	6.95	7.69	7.73
C10 Capric	5.53	4.97	4.11
C12 Lauric	46.11	47.06	43.32
C14 Myristic	17.53	19.28	21.03
C16 Palmitic	9.34	8.72	10.19
C18: Stearic	2.23	0.80	1.49
C18:1 Oleic	9.01	6.26	7.01
C20 Linoleic & Linolenic	2.85	4.19	3.31

results of Santoso et. al, (1996) on kopyor coconut.

The fatty acid composition of coconut samples presented in Table 5. The oil contained fatty acids from C6 to C20. The fatty acids composition of dikiri coconuts was similar to that of normal mature coconut. Saturated fatty acids constituted nearly 90% of total fatty acids in all coconut samples. This confirms with 88.50-97.00 in dry samples (Akpan et. al, 2006). Among them lauric acid is the main fatty acids followed by myristic acids. This supports results reported by Tyler et.al, 1977 for lauric acid (47.60%) and Myristic acid (15.80%). Unsaturated fatty acid composed approximately 10% of total fatty acids. The characteristic fatty acids constituents in dikiri coconut show no difference from those of the earlier workers.

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