ABSTRACT

Gewang (Corypha utan Lam.) is a palm species which grows in the dry land and is distributed from North-east India to North Australia. Almost the whole part of that species has been utilized by Timor Island villagers for daily needs such as building construction, handicraft, animal fodder, alcohol beverages, sugar, and food. As food, gewang starch is extracted from its trunk. Before that starch is consumed, it is cooked with shredded coconut, named "asalan bilan" or "putu" laka". This food becomes common food, especially in isolated area in Timor Island. Based on our analyses, nutrient content of 100 gr gewang starch is as follow: 11.995 g water, 0.518 g ash, 0.202 g fat, 6.591 g protein, 86.594 g carbohydrate, 32.726 g amylose, 51.11 g amylopectin, 12.278 g glucomannan, 100.52 mg calcium (Ca), 136.74 mg phosphorus (P), 3.390 mg iron (Fe), 0.108 mg vitamin B1. These results suggest those gewang starch nutrient contents are almost similar to sago starch, extracted from sago palm (Metroxylon sagu). In the future, investigation of gewang starch on their physical characteristics, non-nutrient properties, and processing should be carried out. Prospective, gewang can be used as food alternative, especially in dry land area such as Timor Island and adjacent regions in order to build food security in Indonesia.

Keywords: gewang, food, nutrients, Timor Island
INTRODUCTION

Gewang or talipot palm (Corypha utan, Lat.) is palm species which grows in dry land and is distributed from North-east India to North Australia. This species is wild and spreading widely in East Nusa Tenggara savana. The cultivation of this species has not been done yet.

Gewang is very tall solitary palm (~15 m) with a broad trunk (~50 cm across), tapering, faintly marked with closely-spaced hoops, and with a faint spiral mark. The crown of that species is very large fan-shaped leaves, 3 m across and the massive petiole is being edged with teeth. Gewang can be grown in subtropical and tropical climates with adequate sun, moisture, and space. The species has very large inflorescence which grows at the very top of the mature tree with stiff spreading branches. It produces millions of flowers and dies after the seeding cycle is complete. Rounded fruit diameter is ~2 cm and seed diameter is ~1.5 cm (Ellison and Ellison, 2001; Gibbons, 1998; Whitmore, 1973).

Like other species in genus Corypha, gewang is associated with human settlements. Almost the whole part of gewang has been utilized for daily needs by villagers in Timor Island, varied from building construction, handicraft, animal fodder, alcohol beverages, sugar and food. The gewang starch, used as food, is extracted from its trunk (Naiola et al., 2007; Uhl and Dransfield, 1987).

Worldwide consumers have faced the rising of food price. On 24 March 2008, CNN stated that food prices are rising across the world because of freak weather and dramatic changes in the global economy, such as higher oil prices, lower food reserves and growing consumer demand in China and India. In long term, food prices are expected to be stable as farmers will grow more grains either for fuel or food. This will bring grain prices down. It is happened in United States, Canada and Europe in 2009 as they grew more wheat-crops. However, FAO projects reported that consumers still face more expensive food at least until 2018. It is rare that the spikes are hitting all major foods in most countries at once. In USA, food prices rose 4% in 2007, which was the highest price since 1990. In December 2007, thirteen seven countries faced food crises, and 20 countries of those had imposed some sort of food-price controls. In the 1990s and 1980s, farm subsidies and support programs allowed major grain export countries to hold large surpluses, which could be tapped during shortages to keep prices down. But new trade policies have agricultural production much more responsive to market demand putting global food reserves at their lowest since 1983.

Indonesia will also face food crises if their agric intensification and extensification programs could not meet national food demand in the future. The Government of Indonesia has placed the identification and development of alternative as an important issues in Medium Term Development Plan (RPJM) 2005-2009 and it has been continued to RPJM 2014. One of gewang starch prospective is as food alternative.

MATERIALS AND METHODS

Materials

In this study, gewang starch was extracted from six samples collected from Fatubesi Village, Manuola District, Regency and other 3 samples from Oele’u Village, Ayatupas District, Tengah Selatan Regency. Gewang starch extraction was done by villagers and its extracting process was documented by investigators.

Methods

The nutrient contents of gewang starch are fats, protein, carbohydrates, amylose, amylopectin, glucomannan, minerals such as calcium (Ca), phosphorus (P), iron (Fe) and vitamins such as B1, were analyzed using these methods as listed in Table 1.
Screw-Based Approach for Food Safety Management

INTRODUCTION

Gewang or talipot palm (Corypha utan Lam.) is palm species that grows in dry land and is distributed from North-east India to the Australia. This species is wild and spreading widely in East Tenggara savana. The cultivation of this species has not been seen yet.

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MATERIALS AND METHODS

Materials

In this study, gewang starch was extracted from six samples, 3 samples were collected from Fatubesi Village, Manoalea District, Belu Regency and other 3 samples from Oele’s Village, Ayatupas District, Timor Tengah Selatan Regency. Gewang starch extraction was done by villagers and its extracting process was documented by the investigators.

Methods

The nutrient contents of gewang starch are fats, proteins, carbohydrates, amylose, amylopectin, glucomannan, minerals such as calcium (Ca), phosphorus (P), iron (Fe) and vitamins such as A and B1, were analyzed using these methods as listed in Table 1.
### RESULTS AND DISCUSSION

Food is any substances that can be eaten or drunk by human either for nutrient needs or pleasure. (http://en.wikipedia.org/wiki/Food). Almost all foods are from plants or animals origin. Many plants or plant parts are eaten as food. About 2,000 plant species are cultivated for food source and many of them have several distinct cultivars (McGee, 2004).

Starch is the most important carbohydrate source in the human diet. Starch have long been used in food products such as noodles and other wheat-based foods, fish crackers, baby foods, bread dough conditioners, ice cream stabilizers, and soup and sauce thickeners (Abd Elgadir et al., 2009). Mostly, starch that is used for food, is usually derived from cereals (corn, wheat, rice, sorghum), tubers (potato, sweet potato), roots (cassava), legumes (mung bean, green pea) and sago palm (Metroxylon sagu), gewang is also highly potential to be us starch source.

The trunk of gewang contains a yellowish starch. In Malay single gewang tree can be extracted to get 100 kg starch (White, 1973) and in Philippines is 90 kg starch (Nasution and Ong, 2009) whereas in Timor Island (Indonesia) is less than 275 kg (Wito et al., 2009). In Philippines, gewang is the third most impc economic palm after coconut (Cocos nucifera) and nipa (Nypa fruticans) (Whitmore, 1973).

In Timor Island, gewang starch has been used as food since long ago. The starch is consumed by baking it with shre coconut, known as “akarbilan” or “puta laka”. That food is the common diet for local people, especially in isolated area in Island. During dry season, this food is consumed daily to replace rice as rice is scarce and become an expensive stuff. Tradition gewang starch is made by extracting its trunk. That process several steps: (1) cutting down gewang palm, (2) removing ba the trunk, (3) slicing inner trunk into small pieces, (4) drying i trunk, (5) separating starch from the trunk fibre, traditionally t ‘lesung’ and ‘alu’, (6) filtering the starch, (7) washing the starch (8)drying the starch (Witono et al., 2009).

Nutrients in food are grouped into several categ. Macronutrients consists of fats, proteins, and carbohydrates micronutrients are the minerals and vitamins. Food also con water and dietary fiber (http://en.wikipedia.org/wiki/Food). food has variation of nutrients and their amount. Rased or analyses, nutrient values of gewang starch are as follows:

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### Table 1. Methods of analysis of gewang starch

<table>
<thead>
<tr>
<th>No.</th>
<th>Nutritional conte</th>
<th>Analysis Method</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water</td>
<td>Drying at 100°-105°C</td>
<td>Jacobs, 1959; Osborne and Voigt, 1978; Slamet et al., 1990</td>
</tr>
<tr>
<td>2</td>
<td>Ash</td>
<td>Drying at 600-650°C</td>
<td>AOAC, 1984; Osborne and Voigt, 1978; Slamet et al., 1990</td>
</tr>
<tr>
<td>1</td>
<td>Fats</td>
<td>Soxhlet</td>
<td>Jacobs, 1959; Slamet et al., 1990</td>
</tr>
<tr>
<td>2</td>
<td>Proteins</td>
<td>Kjeldahl</td>
<td>AOAC, 1990; Jacobs, 1959; Osborne and Voigt, 1978; Slamet et al., 1990</td>
</tr>
<tr>
<td>3</td>
<td>Carbohydrates</td>
<td>Spectrophotometry</td>
<td>Slamet et al., 1990</td>
</tr>
<tr>
<td>4</td>
<td>Amylose</td>
<td>Spectrophotometry</td>
<td>Agryantono et al., 1988</td>
</tr>
<tr>
<td>5</td>
<td>Amylopectin</td>
<td>Spectrophotometry</td>
<td>Agryantono et al., 1988</td>
</tr>
<tr>
<td>6</td>
<td>Glucosemannan</td>
<td>ELPC</td>
<td>AOAC, 1984</td>
</tr>
<tr>
<td>7</td>
<td>Calcium (Ca)</td>
<td>AAS</td>
<td>AOAC, 1984</td>
</tr>
<tr>
<td>8</td>
<td>Phosphorus (P)</td>
<td>AAS</td>
<td>AOAC, 1984</td>
</tr>
<tr>
<td>9</td>
<td>Iron (Fe)</td>
<td>AAS</td>
<td>AOAC, 1984</td>
</tr>
<tr>
<td>10</td>
<td>Vitamin A</td>
<td>ELPC</td>
<td>AOAC, 1984</td>
</tr>
<tr>
<td>11</td>
<td>Vitamin B1</td>
<td>HPLC</td>
<td>AOAC, 1984</td>
</tr>
</tbody>
</table>
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<td>Kjeldahl</td>
<td>AOAC, 1990; Jacobs, 1959; Osborne and Voogt, 1978; Slamet et al., 1990</td>
</tr>
</tbody>
</table>

Carbohydrates: Spectrophotometry
Amylose: Spectrophotometry
Amylopectin: Spectrophotometry
Galactomannan: HPLC
Calcium (Ca): AAS
Phosphorus (P): AAS
Iron (Fe): AAS
Vitamin A: HPLC
Vitamin B1: HPLC

ULTS AND DISCUSSION

Food is any substances that can be eaten or drunk by human or for nutrient needs or pleasure. Starch is the most important carbohydrate source in the human diet. It has been used in food products such as noodles and wheat-based foods, fish crackers, baby foods, bread dough, ice cream stabilizers, and soup and sauce thickeners. Gewang starch is highly derived from various plant species (corn, wheat, rice, sorghum, tubers, sweet potato, roots, legumes, mung bean, green and sago palm). As a sister lineage of sago palm, gewang starch is also highly potential to be used as starch source.

The trunk of gewang contains a yellowish starch. In Malaysia, a single gewang tree can be harvested to extract 100 kg starch (Whitmore, 1973) and in Philippines it is 90 kg starch (Nasution and Ong, 2003), whereas in Timor Island (Indonesia) less than 275 kg (Witono et al., 2009). In Philippines, gewang is the third most important economic palm after coconut (Cocos nucifera) and nipah (Nypa fruticans) (Whitmore, 1973).

In Timor Island, gewang starch has been used as food source since long ago. The starch is consumed by baking it with shredded coconut, known as "akar bilan" or "puta". That food is the most common diet for local people, especially in isolated area in Timor Island. During dry season, this food is consumed daily to replace the rice as rice is scarce and become an expensive stuff. Traditionally, gewang starch is made by extracting its trunk. That process has several steps: (1) cutting down gewang palm, (2) removing bark of the trunk, (3) slicing inner trunk into small pieces, (4) drying inner trunk, (5) separating starch from the trunk fibre, traditionally using 'lesung', (6) filtering the starch, (7) washing the starch, and (8) drying the starch (Witono et al., 2009).

Nutrients in food are grouped into several categories. Macronutrients consist of fats, proteins, and carbohydrates and micronutrients are the minerals and vitamins. Food also contains water and dietary fiber. Each food has variation of nutrients and their amount. Based on our analyses, nutrient values of gewang starch are as follows:
Gewang starch contains fats, proteins, carbohydrates, amylase, amylpectin, glucanamann, Calcium (Ca). Phosphorus (P), Iron (Fe), vitamin A and B1 (Table 2). Fats are a wide group of compounds that are generally soluble in organic solvents and largely insoluble in water. Fat plays a vital role in maintaining healthy skin and hair, insulating organs against shock, maintaining body temperature, and promoting healthy cell function. Fats also serve as energy stores for the body, they are broken down in the body to release glycerol and free fatty acids. The glycerol can be converted into glucose by the liver and thus is used as a source of energy (http://en.wikipedia.org/wiki/Fat). Gewang starch contains 0.202 gr fat per 100 gr. The amount is equal to sago starch (0.20 gr per 100 gr). whereas fat in wheat flour is 1.3 gr and rice flour is 0.5 gr (Direktorat Gizi, Departemen Kesehatan RI, 1981). It means that gewang starch is potentially used for diet program.

### Table 2. Nutrition properties of gewang starch (per 100 gr)

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water (%)</td>
<td>12.882</td>
<td>12.356</td>
<td>12.589</td>
</tr>
<tr>
<td>2</td>
<td>Ash (%)</td>
<td>0.405</td>
<td>0.441</td>
<td>0.399</td>
</tr>
<tr>
<td>3</td>
<td>Fat (%)</td>
<td>0.159</td>
<td>0.137</td>
<td>0.203</td>
</tr>
<tr>
<td>4</td>
<td>Protein (%)</td>
<td>0.160</td>
<td>0.155</td>
<td>0.230</td>
</tr>
<tr>
<td>5</td>
<td>Carbohydrate (%)</td>
<td>80.414</td>
<td>82.936</td>
<td>84.329</td>
</tr>
<tr>
<td>6</td>
<td>Amylose (%)</td>
<td>29.33</td>
<td>32.78</td>
<td>33.47</td>
</tr>
<tr>
<td>7</td>
<td>Glucanamann (%)</td>
<td>0.51</td>
<td>11.39</td>
<td>11.71</td>
</tr>
<tr>
<td>8</td>
<td>Calcium (mg)</td>
<td>59.96</td>
<td>87.06</td>
<td>80.10</td>
</tr>
<tr>
<td>9</td>
<td>Phosphorus (mg)</td>
<td>24.75</td>
<td>19.75</td>
<td>39.03</td>
</tr>
<tr>
<td>10</td>
<td>Fe (mg)</td>
<td>1.95</td>
<td>2.90</td>
<td>4.34</td>
</tr>
<tr>
<td>11</td>
<td>Vitamin A</td>
<td>0.625</td>
<td>0.180</td>
<td>0.110</td>
</tr>
<tr>
<td>12</td>
<td>Vitamin B1 (mg)</td>
<td>0.202</td>
<td>0.106</td>
<td>0.056</td>
</tr>
</tbody>
</table>

Note: Sample 1: Fatubesi Village, Manuhas District, Belu Regency; Sample 2: Oleu Village, Aitarapas District, Timor Tengah Selatan Regency; *Ahmad et al (1999).*

Proteins are organic compounds made of amino acids, are in a linear chain and folded into a globular form. The polymer of amino acids are joined together by the peptide bonds between carboxyl and amino groups of adjacent amino acid residues. (2006). Proteins are building components for body tissues and also a source of energy for most organisms. The protein content in gewang starch is almost equal to sago starch, which is 0.691% 0.700 gr per 100 gr respectively.

Carbohydrates require less water to be digested compared to proteins or fats and are the most important source of energy in things (http://en.wikipedia.org/wiki/Carbohydrate). Based on disease and obesity risk, the Institute of Medicine recommended that American and Canadian adults get 40-65% of dietary energy from carbohydrates (Food and Nutrition Board, 2005), whereas FAO WHO obtained national dietary guidelines for energy from carbohydrates is 55-75% and 10% from sugars (5 carbohydrates) (Joint WHO/FAO expert consultation, 2005). Carbohydrates are inessential nutrients because human body produce all its energy from proteins and fats. The gewang starch contains higher carbohydrate than sago starch which is 86.59% on 84.70 gr per 100 gr respectively. As alternative food, gewang starch does not have health risks such as heart disease and obesity, it is consumed without any additional food.

Amylose can be made of several thousand glucose units, one of the two starch components which another is amylpectin. Amylose is water soluble. Amylose starch is less digestible than amylpectin; however, it takes up less space and is preferred for storage in plants. It makes up about 30% of the starch in plants, though the specific percentage varies by species. Digestive enzyme amylase breaks down the starch molecule maltotriose and maltose. High-amyllose varieties of rice have a lower glycemic load, which could be beneficial for diet (http://en.wikipedia.org/wiki/Amylose). Starch is produce granules in most plants cells. It is referred to native when particular granular state. Native starches from different but sources are vary in structure and compo (http://www.cheng.cam.ac.uk/research/groups/polymer/RMP/nitin/Starchstructure.html). Amylose composition in gewang starch is higher than sago starch which is 32.726% and 21%...
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Carbohydrates require less water to be digested compare to proteins or fats and are the most common source of energy in living things (http://en.wikipedia.org/wiki/Carbohydrate). Based on heart disease and obesity risk, the Institute of Medicine recommends American and Canadian adults to get 40-65% of dietary energy from carbohydrates (Food and Nutrition Board, 2005), whereas FAO and WHO obtained national dietary guidelines for energy from carbohydrate is 55-75% and 10% from sugars (simple carbohydrates) (Joint WHO/FAO expert consultation, 2003). Carbohydrates are inessential nutrients because human body can produce all its energy from proteins and fats. The gewang starch contains higher carbohydrate than sago starch which is 86,594 gr and 84.70 gr per 100 gr respectively. As alternative food, gewang starch does not have health risks such as heart disease and obesity, since it is consumed without any additional food.

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respectively. According to Ahmad et al. (1999), the difference of sago amyllose content is most likely risen as a result of sago harvesting at different growth stages.

Amylopectin is water insoluble and consists of large-high branched molecules, making up the majority of the plants' starch. Properties of amylpectin such as water solubility and bonding capacity make it more useful for technical applications in the food, paper, and chemical industries. The food industry also takes advantage of its properties. Usually, amyllose and amylpectin must be separated or modified by chemical, physical, or enzymatic (http://www.gmo-safety.eu/en/glossary/). Starch is made of about 70% amylpectin by weight, though it varies depending on the source (http://en.wikipedia.org/wiki/Amylopectin). However, gewang starch contains only 51.11% of amylpectin, so identification and further investigation on physical and functional characterization is necessary for food industry.

Glucomannan is a water-soluble polysaccharide that is considered as dietary fiber. Glucomannan is food additive used as an emulsifier and thickener. Glucomannan comprises 40% by dry weight of the konjac plant roots or corm of the konjac plant (Amorphophallus konjac) (http://en.wikipedia.org/wiki/Glucomannan). Clinical evidence suggests glucomannan may be beneficial for weight loss (Keithley and Swanson, 2005). Because it is a soluble fiber, it absorbs water to form viscous gel-like mass. This mass may promote satiety feelings while it is traveling through the gastrointestinal tract. In obese patients, taking 1 gram of glucomannan with 250 ml of water 1 hour before each of 3 meals daily over 8 weeks resulted 25 kg weight reduction in average (Walsh et al., 1984). Gewang starch contains 12.278% glucomannan, so the starch is potentially reduced to weight like konjac starch in Japan.

Calcium is the fifth most abundant element by mass in the human body. Calcium is an important component of a healthy diet and necessary mineral for life because it plays important role in building stronger and denser bones in early life and keeping strong and healthy bones in later life. Calcium supplements are used to prevent and treat calcium deficiencies. Most experts recommend calcium supplements to be taken with food. The calcium supplements should be taken no more than 600 mg in one time because the percentage of calcium absorption will decrease as the amount of calcium in supplement increases. Therefore, it is recommended spread calcium dosage throughout the day. Recommended calcium intake for adults ranges from 1000 to 1500 mg and cal supplements should be taken with food to increase calcium absorption. As a result of sago harvesting at savanna of Timor Island with rich phosphorus soil, whereas palm grows in peat swamp forest with poor phosphorus. Phosphorus can also interfere with the iron absorption. This can eventually lead to bone maintenance and osteoporosis, or brittle bones. Excess phosphorus can also interfere with the iron absorption. Phosphorus is not toxic since it is stored in the body, but long-term excess may result in inhibiting of calcium absorption (http://www.healthvitaminsguide.com/minerals/phosphorus/). As a comparison, gewang starch contains high phosphorus (13 mg per 100 gr), whereas sago starch is only 13 mg per 100 gr might be caused by niche of each species. Gewang grows in savanna of Timor Island with rich phosphorus soil, whereas palm grows in peat swamp forest with poor phosphorus. Phosphorus compition in gewang starch, extracted from get tree, from other regions might be low.

Iron (Fe) is great important in human nutrition. The adult contains iron between 3-4 gr and 60-70% of that iron is as circular iron in the blood (Hb iron) and the rest (1 to 1.5 gr) as iron storage. Iron is necessary for many body functions including haemoglobin formation, brain development and function, regulation of body temperature, muscle activity and catecholamine metabolism. Lack of iron will affects immune system, a decrease of circul
effectively. According to Ahmad et al. (1999), the difference of sago lose content is most likely risen as a result of sago harvesting at rent growth stages.

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Glucomannan is a water-soluble polysaccharide that is is termed as dietary fiber. Glucomannan is food additive used as an sitfer and thickener. Glucomannan comprises 40% by dry weight he konjac plant roots or corm of the konjac plant
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Calcium is the fifth most abundant element by mass in the body. Calcium is an important component of a healthy diet necessary mineral for life because it plays important role in ing stronger and denser bones in early life and keeping strong healthy bones in later life. Calcium supplements are used to treat calcium deficiencies. Most experts recommend supplements to be taken with food. The calcium supplements can be taken no more than 600 mg in one time because the percentage of calcium absorption will decrease as the amount of calcium in supplements increases. Therefore, it is recommended to spread calcium dosage throughout the day. Recommended daily calcium intake for adults ranges from 1000 to 1500 mg and calcium supplements should be taken with food to increase calcium absorption
(http://en.wikipedia.org/wiki/Calcium). Based on our analyses, gewang starch has more calcium than sago starch and other common staple food (Table 2 and see Direktorat Gizi Departernen Kesahatan RI, 1981). Having calcium 100.52 mg per 100 gr starch, gewang starch potential is to be used as calcium food additive.

Phosphorus is an essential and second most abundant mineral in the body after calcium. Eighty percent of phosphorus is found in bones and teeth. The other 20% works in body functions. The recommended daily allowance (RDA) of phosphorus for adults is similar to calcium which is 800 mg. Pregnant or breastfeeding women should get 1200 mg daily phosphorus (http://www.healthopedia.com/minerals/phosphorus/). Its functions is mostly with calcium, which needs proper utilization and healthy balance calcium-phosphorus is 2:1. A high phosphorus levels can interfere with calcium absorption. This can eventually lead to poor bone maintenance and osteoporosis, or brittle bones. Excess phosphorus can also interfere with the iron absorption. Phosphorus is not toxic since it is stored in the body, but long-term excessive use may result in inhibiting of calcium absorption (http://www.healthvitaminsguide.com/minerals/phosphorus.htm). As a comparison, gewang starch contains high phosphorus (136.74 mg per 100 gr), whereas sago starch is only 13 mg per 100 gr. It might be caused by nize of each species. Gewang grows in the savanna of Timor Island with rich phosphorus soil, whereas sago palm grows in peat swamp forest with poor phosphorus soil. Phosphorus comption in gewang starch extraced from gewang tree, from other regions might be low.

Iron (Fe) is great important in human nutrition. The adult body contains iron between 3-4 gr and 60-70% of that iron is as circulating iron in the blood (Hb iron) and the rest (1 to 1.5 gr) as iron storage. Iron is necessary for many body functions including haemoglobin formation, brain development and function, regulation of body temperature, muscle activity and catecholamine metabolism. Lack of iron will affects immune system, a decrease of circulating
haemoglobin concentration due to impaired haemoglobin synthesis and followed by nutritional anaemia. Because of iron recycling, the body needs only a small amount of iron. In general, iron requirements becomes greater during rapid tissue and red cell mass expansion, for example, during pregnancy, childhood and adolescence. Iron requirement for different age groups is 0.7 mg for infants (5-12 months), 1.0 mg for children (1-12 years), 1.8 mg for male adolescence (13-16 years) and 2.4 mg for females, and 0.9 mg for adults (http://www.healthvitaminsguide.com/minerals/iron.htm).

Gewang starch contains 3.390 mg iron per 100 gr which is higher more than two folds compare to sago starch (1.50 gr per 100 gr). It means, consuming 27 gr of gewang strach could provide daily needs of adults iron requirements.

Vitamin A is fat-soluble vitamin and widely distributed in animal and plant foods. Plants is the cheapest source of vitamin A which is green leafy vegetables such as spinach and amaranth found abundance in nature throughout the year. The darker the green leaves, the higher the carotene content. Vitamin A is also available in most green and yellow fruits and vegetables [e.g. papaya, mango, pumpkin] and some roots [e.g. carrots]. Vitamin A is essential for growth. It helps normal growth of bones and teeth, particularly in children and young people. As many other vitamins, certain amount of vitamin A is needed, but too much vitamin A is harmful for the health. [http://www.healthvitaminsguide.com/ vitamins/vitamin-a.htm]. Not like sago starch, gewang starch does not have vitamin A. Therefore, additional food containing vitamin A is necessary for gewang starch when it is used as main food.

Vitamin B1 (thiamine) is water-soluble vitamin and known as anti beri-beri substance. Beriberi is disabling condition. It was endemic for centuries in Orient and Pacific islands and it was finally proved to be deficiency disease. The main source of vitamin B1 in Indian diet is cereals [rice and wheat], which contribute 60-85% of the total thiamine requirements. Thiamine in rice loose during milling. Further losses is taken place during washing and cooking the rice. Much thiamine in fruits and vegetables generally will loose during prolonged storage. Thiamine is destroyed in toasting and cooking cereals with baking soda. Thiamin increases the blood circulation, helps blood formation and carbohydrates metabolism. Most thiamine deficiency is due to the abnormal accumulation of thiamine.
Hemoglobin concentration due to impaired hemoglobin synthesis allowed by nutritional anemia. Because of iron recycling, the needs only a small amount of iron. In general, iron requirements increases during rapid tissue and red cell mass expansion, for example, during pregnancy, childhood and adolescence. Iron requirement for different age groups is 0.7 mg for infants (5-12 months), 1.0 mg for children (1-12 years), 1.8 mg for male adolescence (13-16 years) and 2.4 mg for females, and 0.9 mg for adults (http://www.healthvitaminsguide.com/minerals/iron.htm).

Starch contains 3.390 mg iron per 100 gr which is higher than two folds compare to sago starch (1.50 mg per 100 gr). It is, consuming 27 gr of gewang starch could provide daily needs of iron requirements.

Vitamin A is fat-soluble vitamin and widely distributed in all plant foods. Plants is the cheapest source of vitamin A. Green leafy vegetables such as spinach and amaranth foundance in nature throughout the year. The darker the green, the higher the carotene content. Vitamin A is also available in green and yellow fruits and vegetables (e.g. papaya, mango, kin) and some roots (e.g. carrots). Vitamin A is essential for health. It helps normal growth of bones and teeth, particularly in children and young people. As many other vitamins, certain amount of vitamin A is needed, but too much vitamin A is harmful for the body. (http://www.healthvitaminsguide.com/vitamins/vitamin-A).

Not like sago starch, gewang starch does not have vitamin A. Therefore, additional food containing vitamin A is necessary for children when it is used as main food.

Vitamin B1 (thiamine) is water-soluble vitamin and known as beri-beri substance. Beriberi is disabling condition. It was first observed in Orient and Pacific islands and it was finally recognized as deficiency disease. The main source of vitamin B1 is rice diet is cereals (rice and wheat), which contribute 60-85% of total thiamine requirements. Thiamine in rice loose during analyses, nutrition properties of 100 gr gewang starch as follows: amylose 32.726 g, amylopectin 51.11 g, glucomannan 32.726 g, calcium (Ca) 100.52 mg, phosphorus (P) 136.74 mg, iron (Fe) 3.390 mg, Vitamin B1 0.108 mg. The results suggest that the nutrition value of gewang starch is almost equal to rice flour and higher than sago starch.

The analyses showed that nutrition properties of gewang is almost similar to sago starch in general. The colour of gewang starch is white yellowish which indicates that some other components of gewang starch might be present. These components probably belong to antinutritional component which will become impediment for gewang starch as food source. Antinutritional component might not be toxic, but can be lethal in extreme situations (Bhat and Karim, 2009). Further investigation regarding to antinutritional analyses, physical and functional characterization should be done to obtain comprehensive information in order to develop gewang starch for food industry in the future.

CONCLUSION

Cewang starch has been used as food source since long ago. The starch is consumed by local people, especially in isolated area of Timor Island by adding shredded coconut and baking it, known as "alakbilan" or "putalaka". It is consumed daily to replace rice during dry season where rice is scarce and become expensive. Based on our analyses, nutrition properties of 100 gr gewang starch as follows: water 11.995 g, ash 0.518 g, fat 0.202 g, protein 0.691 g, carbohydrate 86.594 g, amylose 32.726 g, amylopectin 51.11 g, glucomannan 12.278 g, calcium (Ca) 100.52 mg, phosphorus (P) 136.74 mg, iron (Fe) 3.390 g, Vitamin B1 0.108 mg. The results suggest that the nutrition value of gewang starch is almost similar to the sago starch,

ACIDS. Without thiamine, the cells cannot utilize oxygen or fuel for energy, the nervous system cannot function properly, and the muscles can not perform best. Thiamine toxicity is uncommon; as excessed thiamin is excreted. However, long-term thiamine supplementation more than 3 grams has been known causing toxicity. (http://www.healthvitaminsguide.com/vitamins/vitamin-B1.htm). The thiamine content of selected foodstuff (mg/100 gr) is as follows: rice flour 0.12 mg, maize 0.38 mg, potato flour 0.04 mg, manihiot starch 0.04 mg, sago starch 0.01 mg and wheat flour 0.12 mg (Direktorat Gizi, Departemen Kesehatan RI, 1981). Gewang starch contains 0.108 mg thiamine per 100 gr. It means the amount of thiamine in gewang starch is almost equal to rice flour and higher than sago starch.
extracted from sago palm (*Metroxylon sagu*). Further investigation regarding to antinutritional analyses, physical and functional characteristic of gewang starch should be done to obtain comprehensive information in order to develop gewang starch for food industry in the future.

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TWO STAGES TEA CHEMICAL WITHERING DURING PEAK SEASON

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ABSTRACT

Research on two stages tea chemical withering during peak season has done in a mini processing laboratory, Research Institute for Tea Cinchona (RTIC). The objective of this research is to manage oversupply tea leaves during peak season related with factory capacities. In the first stage, three treatments of the leaf withering were carried out, i.e. the first stage to reach 60%, 65%, and 70% of moisture content. These treatments were done twice. The withered leaves from the first stage were mixed together as the second stage to reach the moisture content up to 55%. All treated groups were combined with 90, 105 and 120 minutes of enzymatic oxidation. The theaflavin, thearubigins and caffeine contents were analyzed. The data analysis showed that the first withering stage with 65% moisture content and 90 minutes enzymatic oxidation had the highest theaflavin content in the first stage and 120 minutes-oxidation period gave the highest thearubigins content, i.e. 12.39%. In the contrary, the caffeine content was similar for all treatments.

Keyword: chemical withering, theaflavin, thearubigin.

INTRODUCTION

When green leaves arrive at the factory from the field they have a moisture content of 78 to 80%. The standard method of reducing the moisture content to the level suitable for tea manufacture is to let it wither naturally or blow air through it at a temperature at fixed interval depending on the prevailing weather conditions. This normally takes 16 to 20 hours. During this time a number of reaction take place inside the leaf, referred to as chemical withering. Normally, therefore, both physical and chemical processes occur during withering.


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