Nutritional Potential, Health and Food Security Benefits of Taro Colocasia Esculenta (L.): A Review

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Abstract
The objective of this review was to present the nutritional values and other health and food security importance of taro as alternative food for developing countries. The term taro is used to refer to Colocasia esculenta (L.). It is a family of Aracea cultivated for its edible corms. Taro is used as a staple food or subsistence food by millions of people in the developing countries in Asia, Africa and Central America. Taro has much importance in ensuring food security, in earning foreign currency as being a cash crop and also as a means for rural development. Nutritionally, Taro contains more than twice the carbohydrate content of potatoes and yield 135 kcals per 100 g. Taro contains about 11% protein on a dry weight basis. This is more than yam, cassava or sweet potato. Many authors also stated that the protein content of taro is higher than the other root crops in leaves and tuber respectively. It contains 85-87% starch on dry matter basis with small granules size of 3-18 µm and other nutrients such as minerals, Vitamin C, thiamin, riboflavin and niacin better than other cereals. Taro leaves, like higher plants, is rich in protein. The high protein content of the leaves favourably complements the high carbohydrate content of the tubers. In other parts of the world, the leaves of Colocasia esculenta have been reported to be rich in nutrients, including minerals such as calcium, phosphorus, iron, and vitamins like vitamin C, thiamine, riboflavin and niacin. High levels of dietary fibre in taro are also advantageous for their active role in the regulation of intestinal transit, increasing dietary bulk and faeces consistency due to their ability to absorb water. Most rural peoples suffer from malnutrition not because of the economic status but because of inability to utilize the available nutritious raw materials to meet their daily requirements. Now a day, zinc deficiency is widespread and affects the health and well-being of populations worldwide and since taro is one of the few non-animal sources of zinc, its utilization should therefore be pursued to help in the alleviation of zinc deficiency which is associated to stunting.
Keywords: Taro, nutrition, malnutrition, potential, health and food security

Introduction
Taro belongs to aroid family (Aracaceae) and it is in the genus Colocasia. It is widely produced throughout the world for its underground corms (Njintang et al., 2007). Plants of the genus Colocasia are edible aroids with large leaves and one or more food storing in their underground stems (corms) (Adane, 2009). Taro plant is best planted in soil with pH around 5.5–5.6 and in an environment that is high in humidity with rainfall level of 1000 mm each year and optimum temperature around 21–27 ºc (Anonymous, 1999). Because of a long history of vegetative propagation, there is considerable confusion in the taxonomy of the genus Colocasia. Cultivated taro is classified as Colocasia esculenta, but the species is considered to be polymorphic. There are at least two botanical varieties; Colocasia esculenta (L.) Schott var. esculenta and Colocasia esculenta (L.) Schott var. antiquorum (Schott) Hubbard & Rehder (FAO, 1999).

Origins and production of taro
Taro originates from humid tropical rainforest regions of Southeast Asia including India. Different researchers conclude that it is not possible to determine a single centre of origin for taro (Lebot, 1999). Evidence from the highlands of Papua New Guinea, indicates that taro processing was active by at least 10, 000 years, while Alocasia and Colocasia starch residues have been found on stone implements from Buka, Solomon Islands that date back some 28000 years ago (Loy et al., 1992). The species is now found throughout the Pacific islands and worldwide. The bulk of world production of taro is in Africa, followed by Asia and then Oceania. The major producers in Asia are China, Japan, Philippines and Thailand; while in Oceania, production is dominated by Papua New Guinea, Samoa, Solomon Islands, Tonga and Fiji (FAO, 1999). In Africa, Nigeria, Ivory coast, Ghana, Zaire (Congo) and Cameroon are the dominant producers (FAO, 2008a). According to CSA, 2010/11, in Ethiopia potato, sweet potato and taro are currently planted on about 57514.01, 74065.43 and 37781.28 hectares of land contributing 12.71%, 16.36% and 8.38% to the total root crops covered area at country level, respectively. From the total land area covered by each of the above mentioned crops, about 4596.83, 7477.95 and 3318.03 tons, which accounted for about 19.30%, 31.40% and 13.93% of the total root crops were estimated produced,

respectively.

In Eastern Africa, 407,437 Mt of taro from 73,454 ha with an average yield of 5.5 t/ha was obtained (FAO, 2004). In Ethiopia, root crops are grown widely in the south region. Among these crops, taro is one of the important food source as well as income source to the farmer. It has a great potential to supply high quality food and one of the cheapest source of energy (Patrick *et al.*, 1999).The total area of cultivation of taro in Ethiopia is 26,506.36 ha out of which 20,100.48 ha cultivated in SNNPR 6,147.87 ha in Oromia, 231.84 ha in Gambela and 9.36 ha in Benishangule Gumuz region. In Wolita Zone, the total area under taro cultivation is 4,202.46 ha (CSA, 2003).

Nutrition and other importance of taro

The nutritional value is the main concern when a crop is being considered as a food source. Due to the emphasis placed on the nutritional value of food by consumers, a great need exists for information on the nutritional contents of root crops (Huang, *et al.,* 2007). The high starch content of most root crops is considered as an excellent energy source, but they are marginal to poor sources of protein. Root crops contain a wide variety of minerals and trace elements, including relatively substantial quantities of iron and calcium, as well as potassium and magnesium. Root crops are usually a good source of vitamins, e.g., yellow cultivars of the sweet potato or giant swamp taro are considered to provide ample b-carotene (Huang, *et al.,* 2007). Starch is the most important component (73-80%) of taro (Njintang *et al.,* 2007). Taro proximal composition varies depending on the variety, growing conditions, kind of soil, moisture and fertilizer application, maturity at harvest, post-harvest management and storage. In general, protein and fat content at corm are low but it is high in carbohydrates, fiber and minerals. About 11 % of the total protein in taro is albumin with high amounts of phenylalanine and leucine. The protein of taro is well supplied with hundred essential amino acids though in low histidine and lysine (Arnavid-vinas and Lorenz, 1999).

Although the roots are the most widely consumed and important parts of the plant, the leaves, and rhizomes of taro are eaten depending on the cultivar and the culture. In Asia/ Pacific regions, for instance, the leaves are usually boiled and or prepared in various ways mixed with other seasoners. Taro can be consumed as boiled, baked, roasted or fried and in conjunction with fish, and coconut preparations (Jane, J.„ 1992). Taro flour in precooked forms may find good uses in pastry filling, binder in sausage and as emulsifier in food systems (Fagbemi and Olaofe, 1998). In Ethiopia, processed forms of taro are uncommon. However, in southern part of Ethiopia especially in Wolita zone simply boiled and consumed as similar to potatoes.

Nutritional quality and Chemical composition of taro

The nutritional composition of taro corm like other root crops is low in protein and low in fat, but high in the carbohydrate. It is a good source of potassium and provides moderate level of phosphorus. It is low in vitamin C and deficient in the vitamins A. Taro corm is a good source of minerals and the small granule size of its starch helps increase the bioavailability of its nutrients due to efficiency of digestion and absorption (Standal, 1983).

Chemical composition of Taro

Starch: Taro corm has been reported to have 70–80% (dry weight basis) starch with small granules (Jane *et al*., 1992). Because of the small sizes (1–4 μm in diameter) of its starch granules, taro is highly digestible and as such has been reported to be used for the preparation of infant foods in Hawaii and other Pacific islands (Jane, J., 1992). Taro starch is considered to be easily digestible; hence it is widely used in baby foods and the diets of people allergic to cereals and children sensitive to milk. Taro starch, in view of its small granule size, has also been used for industrial applications (Wang, 1983). Taro starch is easily digestible, the starch grains are fine and very small, it has hypoallergenic nature (low tendency to cause allergic reactions) (Jane *et al*., 1997; Kochhar, 1998) and also the starch is gluten free

Taro starch is also good for peptic ulcer patients, patients with pancreatic disease, chronic liver problems and inflammatory bowel disease and gall bladder disease (Emmanuel-Ikpeme, *et al*., 2007). The size of the starch granules varies with the variety and ranges from 1.5 to 6.6 µm. The shape is polygonal. Taro starch contains about 50% less amylose and an amylopectin content which is higher compared to other cereals. The amylose/amylopectin ratio is 1:7. The taro starch forms a clear and soft paste similar to potato starch. Starch gelatinization temperature is dependent on the variety as well as of the maturity at harvest and is lower as the age increases, ranging from 63- 73^{0}C. The most important sugar in taro is sucrose, but fructose, maltose, glucose and raffinose are also present. Malic acid is the most important organic acid (60%) followed by citric acid (25%) and oxalic acid (15%) (Arnavid-vinas and Lorenz, 1999).

Moisture: Since taro is root crop its moisture content is very high and accounts two third of the total weight of the fresh crops (FAO, 1999). Moisture content of taro varies with variety, growth condition and harvest time. In general the moisture content of taro ranges from 60-83% (Huang *et al.,* 2007).

Protein: Taro contains about 11% protein on a dry weight basis. This is more than yam, cassava or sweet potato. The protein fraction is rich in essential amino acids of trionine, leucine, arganine, valine and phnylalanine. Among the essential amino acids methionine, lycine, cystine, phnylalanine and leucine are relatively abundant in the leaf than the corm. The protein content of the corm is higher towards the corm's periphery than towards its centre. This implies that care should be taken when peeling the corm; otherwise a significant amount of the protein could be lost in the peeling. Concerning the leaf, like higher plant, taro leaf is rich in protein. It contains about 23% protein on a dry weight basis (FAO, 1999). Based on the above information the amino acid profile of taro grown in Ethiopia need to be investigated.

Taro composes high protein than other root crops because of the presence of symbiotic soil bacteria in the root and rhizome part of taro. These bacteria fix atmospheric bacteria and increase nitrogen occurrence in the corm and leaf (Lucy, M et al., 2004). More over the bacteria used as plant growth enhancer due to release of growth hormone to root and distributed to the whole part of the plant. The free-living nature of these soils bacterial also helps the taro crop to grow at different environmental and ecologic conditions (Lucy, M et al., 2004). These properties have economic and ecologic important to the environment.

Fat: As many other root and tuber crops the fat content of taro is very low and its fat content is mainly composed of the lipids of the cell membrane and it is also variable among cultivars. In general the fat contents of taro root range from 0.3-0.6% (FAO, 1999).

Crude fiber: Taro contains both dietary and non-dietary fiber. In a research conducted on six cultivars of taro in Cameroon and Chad it was found that the crude fiber content of taro ranges from 0.3-3.8% (FAO, 1999). Also in another study conducted in six cultivars of taro grown in American Samoa the total soluble and insoluble fiber of taro even a larger range from 5.02-9.01% (Nip *et al.*, 1989). Crude fiber has many desirable functional properties. These include facilitating alimentary functions, helping in micro-component delivery and glucose metabolism and also slowing down the process of re-absorption of undesirable dietary components such as cholesterol, decrease intestinal transit time, reduce total and LDL cholesterol in the blood, decrease post prandial blood glucose and insulin level, buffer excessive acid in the stomach, prevent constipation, increase water holding capacity of food, increase stability of food by modifying structure and density of food, textures the food, gel formation in the food, thickening capacity in the food (Nijoku and Ohia, 2007).

Total ash: Taro contains fairly high amount of ash. From which it can be inferred it contain good mineral contents. The ash contents of taro ranged from 3.54 - 7.78% (Nijoku and Ohia, 2007; Mbofung *et al*., 2006).

Mineral: Taro is a good source of minerals including iron (8.66-10.8 mg/100g), calcium (31-132mg/100g), sodium (82-1521.34mg/100g), magnesium (118-415.07mg/100g), phosphorus (72.21-340mg/100g), zinc (2.63mg/100g), copper (1.04mg/100g) and an excellent source of potassium (2271-4276.06mg/100g). High potassium to sodium ratio food recommended for patient with high blood pressure.

Vitamins: Vitamin C and vitamin B complex (niacin, riboflavin and thiamin) which are important constituents of human diet, are present in appreciable quantity in corms and leafs of taro. Like other roots and tubers are deficient in most other vitamins but contain significant amounts of dietary fiber. Cooked leaf of Taro contains beta carotene, iron and folic acid which protects against anemia (FAO, 1990). There are about 1530 calories in one pound of malanga (*xanthosoma*) flour (Jirarat, Sukryedee, & Pasawadee, 2006). The composition of malanaga flour is approximately: 75.5% carbohydrates, 5.1% protein, 1.6% flat, 9.8% fiber, 1.2% water and 6.8% minerals (Njoku *et al.,* 2007).

Health benefits of taro

Phytochemicals

Taros have high amount of β-carotene in the corm and will impart vitamin A and antioxidant property in the body. B-carotene differs only very slightly in terms of structure. They are very common carotenoids, and are antioxidants, as well as having other potential health benefits. As mentioned earlier, both can be converted into vitamin A by the body, though β-carotene has about twice the provitamin A activity as α- carotene (Nip, 1997).

Phenolic acids

These are simple phenolic acids that are widely distributed in the cell walls of plants and consequently are significant components of the human diet. They have been studied largely in relation to antioxidant activity though these have been largely *in vitro* studies and further work regarding *in vivo* effects in humans is needed before health benefits can be claimed. Yellow-fleshed cultivar of taro is associated with a high level of total phenolic compounds (Foley et al. (1999).

Anti–nutritional Factors limiting utilization of taro

Anti-nutrients which found in taro root have negative implications for taro as a food, yet they also have positive implications for taro as a crop that can be grown with minimal use of fungicides and pesticides. The main anti-nutrients that exist in taro are: mucilage, oxalic acid, tannins, cyanide, lectins, alpha–amylase inhibitors, protease (trypsin and chymotrypsin) and inhibitors (Ramanatha *et al.,* 2010).

Mucilage

When raw taro corms are cut in to pieces, the exposed surfaces often exude droplets of a slimy substance called mucilage. The pieces or slices of corm are washed or placed in portable water; a great quantity of mucilage is quickly released or avoided. The crude mucilage is a complex mixture composed mainly of neutral polysaccharides, with small quantities of fiber and protein (Nip, 1997). Mucilage can be removed by discarding the water used for cooking, or acid ingredients such as lemon juice can be used to neutralize the slimy effect, or the taro can be cooked without water (*e.g.* fried or baked) in a manner that leads to partial dehydration and a dry texture. However, the mucilage in taro corms are important for health because of digestibility and lower blood cholesterol by binding bile, slow blood glucose, slow transit of food through upper GI tract, absorb water and hold moisture that soften stool (Hollyer *et al*., (1997).

Oxalic acid / oxalates

Oxalates are one major limiting factor in the utilization of taro is the presence of oxalates which impart acrid taste or cause irritation when raw or unprocessed foods from them are eaten. This acridity is caused by needle–like calcium oxalate crystals, raphides that can penetrate soft skin (Bradbury and Nixon, 1998). Thereafter an irritant present on the raphides, probably a protease can cause discomfort in the tissue (Bradbury and Nixon, 1998). High oxalate concentrations in the leaves and corms of plants consumed daily are of concern because of the harmful health effects associated with the intake of high amounts of oxalates (Savage and Catherwood, 2007). In large quantities, oxalic acid is poisonous to humans and can also reduce the nutritional value of a food by binding with calcium to form calcium oxalate. Bradbury and Holloway (1988) determined the amounts of total oxalate, soluble oxalate, calcium oxalate, and free calcium in taro corms and leaves, and found that the amount of free calcium is adequate for human nutrition. According to Standal (1983);

All parts of most cultivars were known to contain calcium oxalate, which is destroyed by lengthy cooking. Boiling taro corm at 90 ^{o}C for 30 minutes and steeping in water at 30 ^{0}C for 24 hours can reduce the oxalate-salt content to 32.7% and 56.7% of its original content, respectively. Since taro is a staple food it is important to investigate whether the oxalate content of taro leaves poses a risk factor and whether different methods of preparation and cooking can reduce the risk of absorbing excess soluble oxalates when consumed as part of the diet.

Wild taro is abundant, particularly in wet lands and is highly resistant to pest and diseases. The wild taro leaf has a high nutritive value, with 22.5-26.3% crude protein (Malavanh Chittavong et al 2008b). However, in common with other species of the Aracae family, calcium oxalate (an anti-nutritional factor), is found in all parts of the plant, causing irritation in the throat and mouth epithelium and indirectly affecting the digestibility. Research conducted by Esayas Ayele on effect of boiling temperature on ant-nutritional factors of taro showed that degrading the anti-nutritional factors by boiling so as to make the nutrients available; and making it safe to eat. Different boiling methods used in the study have varied effect in reducing the level of oxalate and phytate and enhanced the mineral content (Esayas Ayele, 2009).

The soluble oxalate content can be reduced by soaking or cooking. Soaking for 18 h can reduce the soluble oxalate content by 26%. During the soaking treatment the insoluble oxalate (calcium oxalate) content of the leaves remained constant (mean 171 mg oxalate/100 g wet matter). Boiling the taro leaves resulted in a 36% loss of soluble oxalates, while the soluble oxalate content of baked tissue was very similar to the raw tissue. The mean insoluble oxalate content of the raw, boiled and baked tissue was 226 mg oxalate/100 g fresh matter. Overall, boiling the taro leaves was shown to be an effective way of reducing the soluble oxalate content of the tissue. Besides, the calcium oxalate content in taro leaf can also be reduced by sun-drying and ensiling, and Emmans G C 2008 reported that these processes can reduce calcium oxalate from 3.08 % in DM in the fresh leaf to 1.1 % after sun-drying and 0.11 % after storing.

Protease (trypsin and chymotrypsin) inhibitors

According to Bradbury and Nixon (1998), acridity is caused by protease inhibitors (protein-degrading enzyme). Acridity is found in the corms and is experienced as a severe itching, stinging or burning sensation in the mouth and throat, followed by swelling or as a less severe irritation or itching of external skin (Osisiogu *et al*., 1974). Acridity in taro is thought to be important as a natural defense against grazing animals (Bradbury and Holloway 1988). Hollyer *et al*., (1997) suggested several possible ways including wash with acidic ingredients or sodium bicarbonate can help to reduce acridity. The inhibitors constitute some 1- 4% of the total crude protein in corms, and are absent or inactive in leaves. When corms are cooked, trypsin inhibitor activity increases at first, but is eventually lost. Twenty minutes of boiling is sufficient to remove trypsin activity and is also sufficient to remove the acridity in many taro cultivars

lectins

Plant lectins are an extremely heterogeneous group of proteins that have only one property in common, namely their ability to bind carbohydrates lectins may act as storage proteins that support new growth during the plant lifecycle, and also as biochemical defence molecules that anticipate attack by microorganisms or plant-eating organisms such as nematodes, insects, and other higher animals. Van Damme *et al.* (1995) noted that lectins are the most prominent proteins in the storage tissues of taro and other Araceae, and suggested that aroid lectins are storage proteins with the additional function of biochemical defence. Heating the lectin to 100ºC for 20 minutes (a common length of time for cooking taro) eliminated its ability to reduce its inhibitor effect.

Alpha-amylase inhibitors

Alpha-amylases are enzymes that help animals and humans to digest starch. The enzymes are found in saliva and the small intestine, and can be inhibited by enzyme-specific inhibitors from many plants. The presence of alpha-amylase inhibitors in taro corms can inactivate human salivary and pancreatic amylases (Soudy ID, et al., 2010). However alpha-amylase inhibitors are not very resistant to heat, losing activity in vitro after boiling for 30 minutes. If usual cooking practices do not deactivate these inhibitors, then they are reasonable tolerated by humans, and may be of little concern. This argument needs to be tested experimentally.

Processing of taro in to different products

The traditional ways to cook taro are roasting on stones or baking in a ground oven. More modern ways are boiling and steaming, or baking in an oven (Soudy ID, et al., 2010). Taro retains its food value if cooked whole and in its skin. It must be cooked thoroughly to prevent mouth and throat itching. Taro corms and leaves are usually consumed by humans after heat treatments, such as boiling, blanching, steaming, stewing, frying and pressure cooking. These methods are found to be effective in improving digestibility, increasing nutrient bioavailability and also minimizing anti-nutritional factors and food-borne diseases.

Processing taro corm affects its proximate composition, mineral content, phytochemical components and antinutrient (oxalate and phytate) contents. When taro corms processed into powder and further decrease will occur when processed into taro noodles and cookies (Soudy ID, et al., 2010). Therefore the combination of cooking time temperature program is necessary to preserves the nutrients and deactivates the anti-nutritional factors. On other hand cooking increases antioxidant activity, crude fat, crude protein and crude fibre contents cooking substantially can used in the management non communicable illness such as obesity, heart disease, blood pressure, Diabetes, cancer and gastrointestinal disorders because of the high fibre content (Soudy ID, et al., 2010).

Drying methods suitable for taro

The dried product quality and drying time are depends on the size of slices. Cutting large size produce into small pieces has been mentioned by authors (El–Sebaii *et al*., 2002) as a way to accelerate drying due to increased surface area of the product and also avoid case hardening. For general food drying, it is commonly recommended to cut produce into thin pieces of not more than about 0.6–1.0 cm (1/4–3/8 inch) (Kerr, 2008).

Several drying methods are commercially available and the selection of the optimal method is determined by quality requirements, raw material characteristics, and economic factors. There are three types of drying processes: sun and solar drying, atmospheric dehydration including stationary or batch processes (kiln, tower and cabinet driers) and continuous processes (tunnel, continuous belt, belt–trough, fluidized–bed, explosion puffing, foam–mat, spray, drum, and microwave–heated driers) and sub atmospheric dehydration (vacuum shelf, vacuum belt, vacuum drum, and freeze driers) (Anon, 2001).

Sun drying is the oldest and easiest method of preservation based on reducing the moisture content of the Root and Tuber to a very low level. The concentration of soluble solids becomes relatively chemically stable. It is no longer a substrate for the growth of molds, yeasts and bacteria, thus preventing spoilage during storage. Even today, the process is preferable because it lowers the cost of packaging, storing and transportation by reducing both the weight and volume of the final product (Mandhyan *et al*., 1988). As Njitang *et al*. (2007) studies sun drying had no effect on the pasting properties but it had more elastic paste and higher browning index of yam flour paste where as solar dryer had high quality of taro flour paste may be due to the slow rate of dehydration. Solar drying refers to methods of using the sun's energy for drying, but excludes open air sun drying. A solar dryer is an enclosed unit, to keep the food safe from damages from, birds, insects and unexpected rainfall. According to Baker and Christopher (1997) there are three types of solar dryers and they are classified according to the type of energy used. Solar natural dryers, Semi-artificial dryers and Solar-assisted dryers

Solar natural drying is mainly used as substitutes for traditional open-air drying methods in areas where no other source of energy is available. In contrast to these traditional methods, however, losses and damage to the product caused by rain, dust, insects, birds and other animals, as well as the pollution from the atmosphere are avoided by the purpose built construction (*i.e.* cabinet and tent type arrangements).

Oven drying is the most widely used method to produce dried foods and agricultural products (Vega–Mercado *et al*., 2001) due to the low investment and operating cost. However, a disadvantage of hot–air drying is that it takes a long time, even at high temperature, which in turn may cause serious damage to the product's quality attributes, such as flavor, color, texture, nutrient status and beneficial substances to health (Tsami *et al*., 1999).

Taro flour

A major problem of taro is that the corms are susceptible to physical damage during harvesting and thus leading to high post harvest losses (Onwueme and Simha, 1991; FAO, 2006). To overcome these losses, the corms and cormels may be processed into flour (Onyeike *et al*., 1995). According to Kwarteng and Towler (1994) taro flours stored much longer than the unprocessed tubers.

Several tuber products are accepted and preserved as flours after appropriate drying. Flours role in the feed and in food industry is very important (Nip, 1997). Trying to produce them from new sources is necessary. Taro flour makes part of the new types of flour. Some recent studies establish a simple process to produce taro flour. In this process taro tuber are cooked in its skin, peeled, sun dried and ground through 500 µm sieves (Njintang and Mbofung, 2003). The taro flour can then be used in other food formulations such as taro bread, taro cookies, baby food, pasta, or other products (Nip, 1990). The corm's flour is also a good source of carbohydrate for diabetics and production of weaning food for infants and for those with gastrointestinal disorders (Onwueme, 1978).

Pregelatinization is one of the physical methods used to modify starch. Taro starch gelatinization temperature is dependent on the variety as well as of the maturity at harvest and is lower as the age increases, ranging from 63- 73^0C (Arnavid-Vinas and Lorenz, 1999; Million *et al.,* 2006). This method affects physicochemical and functional properties of flour significantly (Alam and Hasinain, 2009) due to starch granule disruption and such disrupted and pre gelatinized flour can absorb water.

Therefore it can create binder properties to obtain uniform matrix instantly when added to water (Doubliel *et al*., 1986). The solubility of modified starch from taro was studded by Alam and Hasinain, (2009) and found that heat moisture treated starch is more soluble than raw starch. In addition, it was reported that pregelatinized product have higher overall acceptance (Chinnajarn *et al.,* 2006).

Taro chips

Chips made from the bottom of the corm are rated better in appearance than those made from the top part. This is because the bottom part is dryer (around 5 percent greater dry matter content than the top part). Research also indicates that the level of nitrogen fertilizer significantly affects corm dry matter. The more N, the lower the dry matter, and as little as 5 percent differences in fertilizer application can affect chip quality and color (James Hollye et al., 2000).

Conclusion

This review tried to address important information about taro nutritional importance and related information on its cultivation, post harvest management, processing possibilities in order to prolong the shelf life of fresh taro corm. Moreover, from the review important information's are organized to show the nutritional, ant-nutritional components of Taro. Taro is used as a staple food or subsistence food by millions of people in the developing countries in Asia, Africa and Central America and can be consumed as both a staple food and vegetable, and processed as a food ingredient, animal feed. The corms of taro are used as vegetable and considered as a rich source of carbohydrates, proteins, minerals and vitamins and accredited to have medicinal values and are used to reduce tuberculoses, ulcers, pulmonary congestion, fungal infection and reducing body temperature in a feverish patient and others In Ethiopia, root crops are grown widely in the south region and among these crops; taro is one of the important food source as well as income source to the farmer. In the southern part of the country, it has a great potential to supply high quality food and one of the cheapest source of energy.

Nutritionally, taro contains more than twice the carbohydrate content of potatoes and yield 135 kcals per 100 g. Taro contains about 11% protein on a dry weight basis. This is more than yam, cassava or sweet potato also stated that the protein content of taro is higher than the other root crops. It contains 85-87% starch on dry matter basis with small granules and other nutrients such as minerals, Vitamin C, thiamin, riboflavin and niacin better than cereals. Taro leaves, like higher plants, is rich in protein. The high protein content of the leaves favourably complements the high carbohydrate content of the tubers. Underutilized crops such as taro have much importance in ensuring food security, in earning foreign currency as being a cash crop and also as a means for rural development. Most rural peoples suffer from malnutrition not because of the economic status but because of inability to utilize the available nutritious underutilized crops such as taro to meet their daily requirements. To meet the nutritional demand there must be a need to see the economic and nutritional impact of indigenous fresh underutilized crops such as taro for its production and consumption in rural communities. Therefore it can be goodness for malnutrition and food insecurity for rural peoples as rural food sources.

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Table 1. Proximate composition of taro corm on fresh weight basis

Composition	Content [a]	Content [b]	Content [c]
Moisture (%)	68.10	63-85	65.70
Carbohydrate (%)	26.80	13-29	26.30
Protein (%)	0.34	1.4-3	1.10
Fat (%)	0.11	0.16-0.36	0.40
Crud Fiber (%)	2.50	0.6-1.18	2.10
Ash (%)	1.91	0.6-1.3	2.10
Vitamin C (mg/100g)	14.3	7-9	<1
Thiamin (mg/100g)	0.028	0.18	0.11
Riboflavin (mg/100g)	0.029	0.04	0.02
Niacin (mg/100g)	0.78	0.9	1.3

Source: a-Hedges & Lister, (2006). b-Onwume (1999). c- Englis *et al*., (1996).