American Journal of Food, Nutrition and Health
2018; 3(3): 73-77
http://www.aascit.org/journal/ajfnh

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Importance, Nutrient Content and Factors Affecting Nutrient Content of Potato

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Citation
Egata Shunka Tolessa. Importance, Nutrient Content and Factors Affecting Nutrient Content of Potato. *American Journal of Food, Nutrition and Health*. Vol. 3, No. 3, 2018, pp. 37-41.

Received: March 12, 2018; **Accepted**: April 17, 2018; **Published**: June 1, 2018

Abstract: Potato (Solanum toberosum L.) is a source of both food and income in the growing countries of the world which able to change greatly the food security of countries because of its high productivity per unit area and time compared to other crops. It is commonly produced for its tuber (under ground modified stem) which mainly contains carbohydrates. Potato is a multipurpose crop, highly popular worldwide and served in a variety of ways. It is a good source of essential protein, vitamins and minerals. Potato is a moderate source of iron while high in vitamin C content which promotes iron absorption. It is a good source of vitamin B1, B3 and B6 and minerals such as potassium, phosphorus and magnesium. Potatoes also contain dietary antioxidants, which may play a part in preventing diseases related to ageing, and dietary fiber, which benefits health. The nutrient contents are mainly affected by variety, growing environment and processing methods. Thus, it is better to consider the nutrient contents of potato during variety screening, demonstrating and growing potato in relation to the environment.

Keywords: Nutrient Content, Vitamin C, Dietary Fiber and Minerals

1. Introduction

Potato (Solanum toberosum L.) ranks fourth among the world's crop production in volume after wheat, rice and corn [1]. It is first from root and tuber crops followed by cassava, sweet potato and yam [2]. Annual world production of potato is about 330 million metric tons from 18,651,838 ha area coverage and in Africa total production of potato is about 17,625,680 tons from total area coverage of 1,765,617 ha while total production is around 572,333 tons on area coverage of 69784 ha in Ethiopia [3]. Potato was introduced to Ethiopia in 1858 by a German Botanist Schimper [4, 5]. Since then, farmers in Ethiopia highlands began cultivating the potato tuber as compensation when other crops failed. Based on FAO data, potato production in Ethiopia had been increased from 280, 000 tons in 1993 to around 525, 000 tons in 2007 [6] due to the development of relatively high yielding, wider adapted and blight resistant varieties together with agronomic techniques of production by Federal and Regional Research Centers effort basically through introduction and selections. Having the same trend, the annual potato production in Ethiopia reached 1.62 million tons from area coverage of 0.18 million hectares in 2013/14 [7]. This continued increase, showing that how much attention given to the production of the potato crop due to its importance to the food security achievement of the country. But the nutritional content consideration was given less attention. The variety development or selection of the country was done mainly depending on dry matter or total yield in ton/ha and disease reaction. Although, much agronomic activities and variety researches were conducted [8, 9, and 10], none of them considered tuber nutrient concentration [11]. The protein, starch, minerals and vitamins content consideration was neglected. This review is conducted to review the nutritional contents and importance of potato crop as whole in addition to factors affecting the nutritional content.

2. Material and Methods

All available reports, Journals, proceedings and books were used in this review paper from Google and available shelves.

3. Crop Importance

Potato (Solanum toberosum L.) is a source of both food and income in the growing countries of the world which able to change greatly the food security of countries because of high productivity per unit area and time in relation to other crops. In addition, it has high prospects for growth of the

market for fresh potatoes [12]; make the commodity fundamental for rural development, particularly in countries where there is dramatic increase in cereal purchase costs. As a result, potato use for food is increasing from year to year in Ethiopia [13].

Potato is among the worlds' widely grown crops produced for staple food [14]. It is commonly produced for its tuber (under ground modified stem) that mainly contains carbohydrates. The tuber part of the potato is the widely adapted edible potato product which is rich in vitamin-C [6]. It also contains high quality protein and substantial amount of essential vitamins, minerals and trace elements [15]. The protein of potato has a high biological value than proteins of cereals and comparable with that of milk and fish [16]. The biological value of a mixture of egg and potato is higher than the egg alone. Hence, potato can be supplement of egg, meat and milk products for improving their taste, lowering energy intake and reducing food cost. The presence of vitamins and minerals make this crop preventive crop from some diseases caused by deficiencies of those vitamins and minerals available in the edible food item of potato. It also contains dietary fibers that can prevent constipation through increasing the bulk of the stool, and decreasing absorption of dietary cholesterol and thereby lower plasma LDL cholesterol [17]. In addition, potato food helps protect from colon polyps and cancer.

In addition, potato is higher yielding than other crops per unit area and time or season. It has wider climatic zones for production. Potato is a multipurpose crop that produces carbohydrate-rich food which is highly popular worldwide and served in a variety of ways. According to [18] harvested fresh potato tubers contain about 80% water and 20% dry matter, while about 60 to 80 percent of the dry matter is starch. On a dry weight basis, the protein content of potato is similar to that of cereals and is very high in comparison with other roots and tubers [18]. Potatoes are rich in several micronutrients [19]. It is also a moderate source of iron, and high in vitamin C content that promotes iron absorption. According to [6] potato is a good source of vitamins B1, B3 and B6 and minerals such as potassium, phosphorus and magnesium, and contains folate, pantothenic acid and riboflavin. Potatoes also contain dietary antioxidants, which may play a part in preventing diseases related to ageing, and dietary fiber, which benefits health [6]. Though potato has these and other important uses, it is cultivated by blanket recommendation nitrogen rate application and even without the application of potassium fertilizer. But the crop requirement of potassium is higher than N and P rates. According to [20] report potato crop is a heavy feeder of soil potassium as it removes 1.5 times the amount of nitrogen and 4-5 times the amount of phosphate. It is landed property that use of appropriate potassium rates can increase the productivity of the potato crop significantly and boost the contribution of the crop to food security. Significant increase in leaf potassium (K) content was indicated with applied K and showed positive correlation with tuber yield and negative correlation with the frost score [21]. On the other hand, potassium deficient potato crop is found less resistant to diseases and other pests, frost damage, low yielder and poor quality which varied with variety [21]. As the base of food need of human is satisfied based on utilizable nutrient, varietal nutrient assessment is found to be fundamental in order to maximize productivity of varieties per hectare through selecting more nutritive variety for production and verify the variety for the character.

4. Nutrient Content in Relation to Other Crops

Carbohydrate: water accounts for about 70- 80% of a typical potato tuber, though this percentage can vary significantly depending on the type of potato [22]. According to [22] harvested fresh potato tubers contain about 80% water and 20% dry matter, while about 60 to 80 percent of the dry matter is starch depending on variety and growing conditions. Potato also contains small amounts of simple sugars, which are important for developing the golden-brown color of fried and roasted potatoes. Potatoes are very high in starch, and have a high glycemic index (the only vegetable with a higher one is parsnips [23]. This is another way of saying that the carbohydrate in potatoes is rapidly turned into sugar and absorbed into the blood. Potato contains about 17% starch and it is one of the best natural sources of starch [22]. Sprouting potato leads to conversion of starch into sugar and green, which contain poisonous substance Solanine hence you should avoid eating sprouted potatoes. The starch content of potato is highly affected by variety while a little less affected by environment [24]. According to the same source, impact of variety at the total starch variability is 65% and an environmental condition is 19%, while the share of variety and environment interaction is 14%. Carbohydrate content in potatoes depends on a variety and physiological state of tubers, while the presence of carbohydrates may change during tuber development and during the time of storage [25]. According to [26] the carbohydrate content of mature tuber at storing temperatures from 10 to 20° C is starch. But other sugars are taking small amount share [27, 28]. So the varieties carbohydrate content assessment in relation to nitrogen fertilizer and potassium rates is important for breeding, production and variety verification for the character by growing in same growing conditions. It is also required for maximizing productivity of carbohydrate per unit area and time through allowing the selection for better carbohydrate containing variety for production.

Protein: Potato contains 2% high quality protein and a good carbohydrate to protein ratio. When compared with rice and cereals, it has higher lysine content and lower concentrations of other amino acids such as cysteine. The potato is not the only source of high energy food, but also source of high quality protein [15]. According to [29] the crude protein and percentage nitrogen content was found to be improved by fertilization. The potato protein quality is greater than grain protein quality [30]. The quality of protein

from wheat, maize and bean is definitely lower than that of potato [31]. Potato protein quality composition greater than protein content of other crops due to possession of essential amino acid good for human nutrition [32]. According to [15] report, protein content of potato is also easily digestible as it is primarily Albumin and to a lesser extent, globulins composition. The quality of the protein is varied considerably based on growing conditions and variety difference [31]. So that due to breeding and productivity advantage, varieties' protein content potential have to be assessed under the same growth conditions at different levels of nitrogen and potassium as the two works on different physiological and anatomical activities; nitrogen increasing succulence while potassium increasing strength of the plant in addition to investigating their collective effect on nutrient content, yield and disease reaction.

Fats: Fat content of potato is very low, as is, consequently, the occurrence of fat-soluble vitamins. Both the flesh and the skin of a potato contain dietary fiber, though there's a greater concentration in the skin. Fat content differs with variety. In the experiment of [33] different varieties produced different amount of fat, starch, carbohydrate and fiber. The fibers from potato food are a useful dietary fiber that can control constipation. Potato is low in fat, but preparing and serving potatoes with high fat ingredients raises the caloric value of the dish [34]. According to [35] the fat content of 100g of potato is 0.1 g and potato fat is lower than other crops like maize, rice, wheat, soybean, cassava and yam but a little bit higher than sweet potato. Variety fat content investigation is also important, like protein, carbohydrates and other essential elements investigations for the advantage of digestibility and indigestibility of fat available as well as ranking them in their order of importance for the two types of fats.

Vitamins and minerals: Potatoes are rich in several micronutrients [19], especially vitamin C when eaten with its skin [6] and a single medium sized potato of 150 g provides nearly half daily adult requirement (100 mg). Potato is also a moderate source of iron, and its high vitamin C content promotes iron absorption. According to [6] potato is a good source of vitamin B1, B3 and B6 and minerals such as potassium, phosphorus and magnesium, and contains folate, pantothenic acid and riboflavin. Potatoes also contain dietary antioxidants, which may play a part in preventing diseases related to ageing, and dietary fiber, which benefits health [6]. The level of Vitamin C decreased with length of storage and cooking, especially if the potatoes are peeled earlier [36]. According to [37] potato food contains B complex vitamins, especially B1, B6 and niacin as well as other minerals such as magnesium, phosphorous, and rich in potassium. But potatoes have less Sodium and trace elements, from aluminums to zinc, and its iron content can contribute significantly to daily requirements.

In addition to vitamins and minerals, potatoes also contain a mixture of phytochemicals with antioxidant potential, most notably carotenoids and anthocyanins [37, 38]. Anthocyanins are found in the greatest quantities in purple and red potatoes while carotenoids are found largely in yellow and red potatoes, although small amounts are also found in white potatoes [38]. The total antioxidant capacity (TAC) in more than 100 different foods, including fruits, vegetables, nuts, dried fruits, spices, cereals, and other foods were examined [39]. In addition, the researchers measured total phenolic content of these foods to evaluate their contribution to total antioxidant capacity. Potato varieties vitamin and mineral content investigation are also good for selecting promising varieties for production and breeding programs. From these it is important to quantify the vitamin and mineral content of varieties cultivated in the country for their quality and verify them according to the amount they contain to recommend for breeding purposes and promote high containing varieties not only from a nutritional aspect but also health ensuring advantages.

5. Factors Affecting Nutritional Content of Potatoes

Variety: The nutritional content of the potato varieties is variable with the genetic makeup of the variety under cultivation. Significantly different amount of tuber nitrogen content was reported for different varieties in relation to irrigation regimes [40]. Significantly different protein content was identified for varieties [41]. According to [32] different varieties produced different amount of protein, fat, starch, carbohydrate, ash and biologically active compounds: polyphenols, flavonoids, and fiber. The starch content of potato is a varietal characteristic and environment [23] and proportion of variety, contribution to the total starch variability is 65% and environmental conditions are 19% while the share of variety and environment interaction is 14%. Carbohydrate content in potatoes depends on a variety and on the physiological state of tubers [24]. It is easy to understand differences in nutrient content with varietal difference. From these it is important to quantify the nutritional content of varieties cultivated in the country for their quality and verify them according to the amount they contain to recommend for breeding purpose and promote high containing varieties for production.

Growing condition: Growth condition is not only determining the nutrient content, but also determines the type of crop to be grown. As indicated in [23] nutrient content is varietal character and environment. The share of variety at the total starch variability is 65%, the share of environmental conditions is 19% and the share of variety and environment interaction is 14%. It is possible to improve the crude protein and nitrogen percentage by fertilization [28]. The quality of protein is also variable with growing conditions and variety [29]. Irrigation regimes and variety significantly affected the nitrogen content of potato [40]. Growing conditions are also one crucial factor to be considered while dealing about nutrient content in terms of both quantity and quality.

Preparation methods: Since the starch in raw potato cannot be digested by humans, they are prepared for consumption by boiling (with or without the skin), baking or frying. Each

preparation method affects potato composition in a different way, but all reduce fibre and protein content, due to leaching into cooking water and oil, destruction by heat treatment or chemical changes such as oxidation. The most common method of potato preparation worldwide is boiling and it causes a significant loss of vitamin C, especially in peeled potatoes [6]. Frying for a short time in hot oil (140°C to 180°C) results in high absorption of fat and reduces mineral and ascorbic acid content significantly. According to the finding of [6], baking causes slightly higher losses of vitamin C and lower losses of other vitamins and minerals than boiling. Preparation method is one of important factors that can significantly affect the nutrient content.

6. Conclusion

It is concluded that, potato is a source of both food and income in the growing countries of the world which able to change greatly the food security of countries because of high productivity per unit area and time compared to other crops. It is a moderate source of iron and high in vitamin C content which promotes iron absorption. Potato is a good source of vitamin B1, B3 and B6 and minerals such as potassium, phosphorus and magnesium. Potatoes also contain dietary antioxidants, which may play a part in preventing diseases related to ageing, and dietary fiber, which benefits health. Its' nutrient contents are mainly affected by variety, growing environment and processing methods. It is better to consider the nutrient contents of the potato during variety screening, demonstrating and growing potato in relation to the environment.

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