Nutritional quality and Sensory Acceptability of Popular Potato Varieties in Central Highlands of Ethiopia

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Abstract

Potato is an important source of energy and micronutrients to most population in Ethiopia. Despite its importance for food and nutrition security of the country, information on nutritional quality and preference of consumer on different varieties is lacking. The study was conducted to identify popular potato varieties in the central high lands of Ethiopia and to determine their nutritional composition and processing quality. Four popular varieties Gudena, Jalena, Belete and Chala were selected, and their proximate composition, mineral content and product making quality was evaluated using standard methods.Significant ($p<0.05$) variations were observed in dry matter, protein, fat and potassium contents. The nutrient composition analysis of the four varieties showed that Gudena has highest level of protein, Iron and potassium, whereas Jalena was best in zinc content. In sensory evaluation, Belete was preferred in appreance and taste for French fries. Therefore, the four popular potato varieties can be utilized in the processed form to fulfill the daily requirement of nutrients.

Keywords: Potato Variety, Macro-nutrients, Micro-nutrients and potato processing.

Introduction

Potato is a versatile, carbohydrate rich food highly popular worldwide and prepared and served in a variety of ways. It contains about 80 percent water and 20 percent dry matter. 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. In addition, the potato is low in fat and the feeling of satiety that comes from eating potato can help people to control their weight. However, preparing and serving potatoes with high-fat ingredients raises the caloric value of the dish. 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 (FAO, 2008).

Irish Potato (*Solanum tuberosum* L.) is the most widely grown food crop after rice, wheat and maize (Burton, 1989). The crop has its origins in the Andes

Mountains of Peru and Bolivia from where it spread throughout the world.Cultivated potatoes in Ethiopia are exclusively the European and North American type,tetraploid *Solanumtuberosum L*., with a genomic constitution of 2n = 4x = 48. Production of potato is characterized by fairly-structured preferences on the well-acquainted cultivar types for taste, color, productivity and time to tuber balking (Kolech *et al*. 2015, 2016). Potatoes are increasingly becoming important in the diets of many Ethiopians and incorporated into traditional dishes in boiled or fried (Chips and French fries) forms. In major urban centers, they are becoming popular in the form of boiled, French fries and crisps.Therefore, potatoes are a principal source of carbohydrates and protein, and also contribute some vitamins and minerals in the diet. However, information on micronutrient profile of local cultivars, farmer preferences and perception on new and more nutritious potato genotypes are scanty except a study by Abebe et al. (2012) who reported Fe and Zn concentration of three local and 15 released potato varieties.Thus the present study was designed to determine the macro nutrients and mineral compositions of popular varieties grown in central high lands of Ethiopia.

Materials and Methods

A total of 30 representative potato producers were interviewed in Jeldu and Wolmera districts of West Shewa zone using a semi-structured questionnaire. Based on process ability (cooking time, frying and oil absorption) and food preferences (taste, color), four popular potato varieties identified. These varieties are Gudena, Jalena, Belete and Chala with score of 92, 72, 60 and 25% in process ability and food preferences respectively. Samples of identified varieties were collected from potato improvement research program of Holeta Research Center.

Sample preparation

The tubers were washed with tap water, rinsed with deionizer and distilled water. The washed tubers were dried with towel paper. The tubers were peeled and longitudinally cut in four sections by stainless steel slicer. Then 50g was weighed from 2-3 slices of each section and dried at 80°Cfor 72 hrs. The dried samples were then milled by stainless mill and stored in air tight container for analysis.

Proximate Composition

Proximate compositions were determined usingAACC (2000) Method. To determine solid content, five tubers were chopped and mixed thoroughly and 200gweighed. The measured sample was placed in paper bag and put in an oven at 80°C for 72 hours. Crude protein was determined using Kjeldahl method with SBS 2000 analyzer unit (Food ALYT, Germany), where, the percentage nitrogen (%N) obtained was converted in to crude protein (% CP) using the relationship: % CP = % N multiplied by 6.25.Nuclear magnetic resonance spectrophotometer

(NMR) was used to estimate fat content of potato samples. Twenty two gram of the grind sample measured and dried in oven at 105 degree centigrade for two hours and cool in adissector for 30 minute. After cooling, the tube was inserted in to NMR and directly measured the fat content.Total ash was determined by incinerating the samples in a muffle furnace at 550°C for 4hrs. The ash was cooled in a desiccator and weighed. Crude fiber content was determined by dilute acid and alkali hydrolysis. Carbohydrate (CHO) content was calculated as: CHO (%) = 100-(%MC+%CP+%Fat+%Fiber+%Ash).

Mineral contents

Atomic Absorption Spectrometer(AAS) was used to determine Ca, Fe, Na, K and Zn contents of potato samples as described in AOAC (1984).A 0.5gof grinded potato sample was ashed at 550°C for three hours in mufflefurnace. After cooling, thesample was mixed with 2.5ml distilled water and 2.5 ml conc.HCL. The digested sample was filtered and marked with 100ml volumetric flask and the aliquot was measured using AAS.

Potato food product preparation

To undertake sensory evaluation, common potato products including chips, french-fries and Boiled potato were prepared using CIP (2007) method.

Chips: The tubes were cut perpendicular to the long axis and three 0.5 mm slices were taken from the central part of each half. The slices were rinsed in water and shaked. The dried slices were fried in oil at 180°C until the oil stops bubbling for about 3 minutes and the color of the potato chips were evaluated from the standard color chart.

French Fries: The tubers were hand peeled and cut long wise using hand operated chip cutter producing 12mm X 12mm strips in cross section. The cut strips were washed to remove surface starch. The strips were fried at 193°C for three minutes. Boiled potato: The tubers were placed in boiling water until a pin or probe penetrate the tissue and kept it with aluminum foil to present the panelist.

Sensory evaluation

The products were coded and randomly presented to 16 panelistsusing five point hedonic scale (1= dislike very much, 5= like very much). Appearance, taste and texture were used as sensory attributes.

Data analysis

ANOVA was used to analyze the data and means separated by the Least Significant Difference (LSD) using SPSS version 23.

Results and Discussions

Proximate composition of raw potato tubers

Proximate composition of the potato tubers is presented in table 1. There was a significant difference in dry matter contents between the varieties. The dry matter content of Belete was the highest and ranged from 23-24%which falls in the recommended level (>20%) for chips and French fries processing (Kabira and lemaga, 2006). The varieties were also significant in their protein content at P<0.05.The highest protein content was recorded for Gudena (12.84 g/100g) variety and it was comparable with the protein content of the cereals barley (12.3 g/100g) and wheat (11.3 g/100g).This is in agreement with the finding of George et al. (2009) and Augustin et al. (1979).The range of the fat content was from 0.25-1.00. Though the fat content in potato is generally low, it plays an important role to resistenzyme darkening and 75% of potato fats are polyunsaturated that contribute production of desirable flavor in cooked tubers (Woolf,1987).The ash content also differed significantly among the variety at p<0.05. With 6.3% the ash content of Gudenawas the highest while lowest concentration was recorded for the varieties Belete and Chala both with only 3.15%. Variety is reported as an important cause of variation in ash contents (True *et a*l., 1978).There was no significant difference among the varieties in crude fiber, total carbohydrate and energy contents.

Table1. Proximate composition of popular potato varieties in West Shewa, Ethiopia (%)

Macro nutrients	Variety			
	Gudena	Belete	Jalena	Chala
Water content	77.00 ±1.15^{a}	76 ± 1.00^{b}	77 ± 1.02^{b}	76.00± 2.82^{ab}
Dry matter	23 ± 1.15^{b}	24 ± 2.0^{ab}	23 ± 1.02^{ab}	24 ± 2.82^{a}
Moisture content	4.33±0.00^{b}	5.49±0.23^{a}	4.83±0.70^{ab}	4±0.00^{b}
Protein	12.84 ± 1.86^{a}	5.35 ± 2.98^{b}	7.09 ± 1.45^{b}	6.83 ± 1.05^{b}
Fat	0.75 ± 0.45^{b}	0.25 ± 0.00^{b}	0.91 ± 0.38^{ab}	1.00 ± 0.00^{a}
Ash	6.3±0.42^{a}	3.15±0.21^{b}	3.3±0.00^{b}	3.15±0.21^{b}
Fiber	2.05±0.21	1.85±0.49	1.5±0.42	2.5±0.77
Carbohydrate	73.73	83.91	82.37	82.52
Energy (KJ/100g)	353.03	359.29	366.03	366.4

Mineral contents

Significant variations were not recorded in Zn, Fe, Ca and Na contents of the potato varieties at p<0.05 (Table 2). The level of Zn was ranged from Chala (4.5mg/kg) to Jalena (6mg/kg) and it was in line with George et al. (2009). Highest level of iron content was obtained for the variety Gudena (49mg/kg). Potassium was the only mineral which showed a significant variation among the varieties. The raw tubers had high amount of potassium content ranging from Chala (360mg/kg) to Gudena (2334.5mg/kg) and this estimation is comparable

with previous studies (Burton, 1989). Generally, Gudena, Jalena and Chala were better in iron, zinc and calcium contents respectively.

Table2. Mineral contents of popular potato varieties in West Shewa, Ethiopia (mg/kg)

Variety	Minerals				
	Zn	Fe	Ca	K	Na
1.Gudena	5.00 ± 1.41	49 ± 1.84	13 ± 1.22	2334.5 ± 3.27[a]	5.5 ± 2.64
2.Belete	5.33 ± 1.52	36.33 ± 2.4	18.33 ± 1.05	1013.3 ± 1.23[b]	33.3 ± 4.19
3.Jalena	6.0 ± 0.00	34.33 ± 1.5	23.33 ± 1.05	857.3 ± 1.12[b]	33.66 ± 3.73
4.Chala	4.5 ± 0.70	40.0 ± 1.21	24.0 ± 2.8	360 ±14.1[b]	25.00 ± 3.1

Sensory evaluation of potato products

Belete was the most preferred variety by the panelist for the boiled potato appearance and Gudena was preferable in its taste in boiled potato, chips and French fries (Fig 1,2,3). The current results are comparable with the study done by Asefaw et al. (2018).

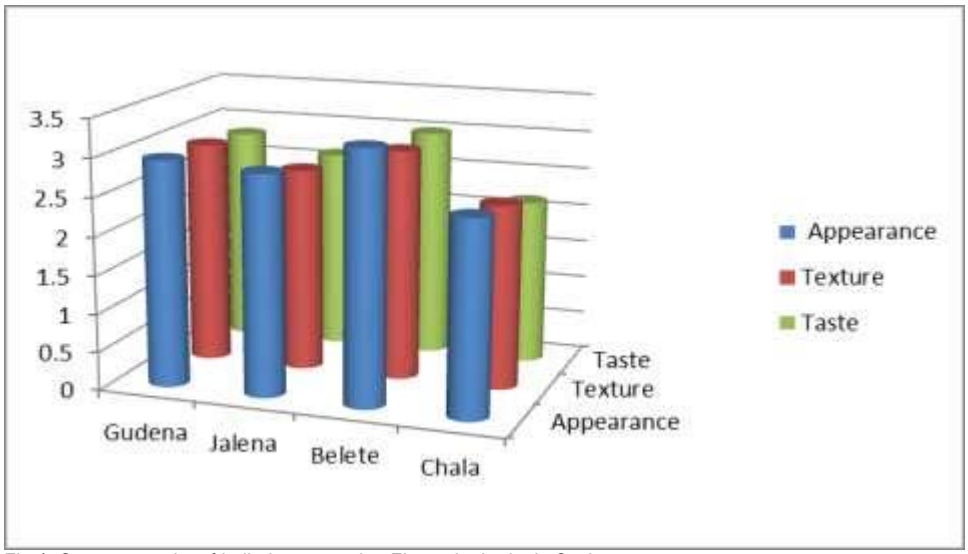

Fig 1. Sensory results of boiled potato using Five point hedonic Scale

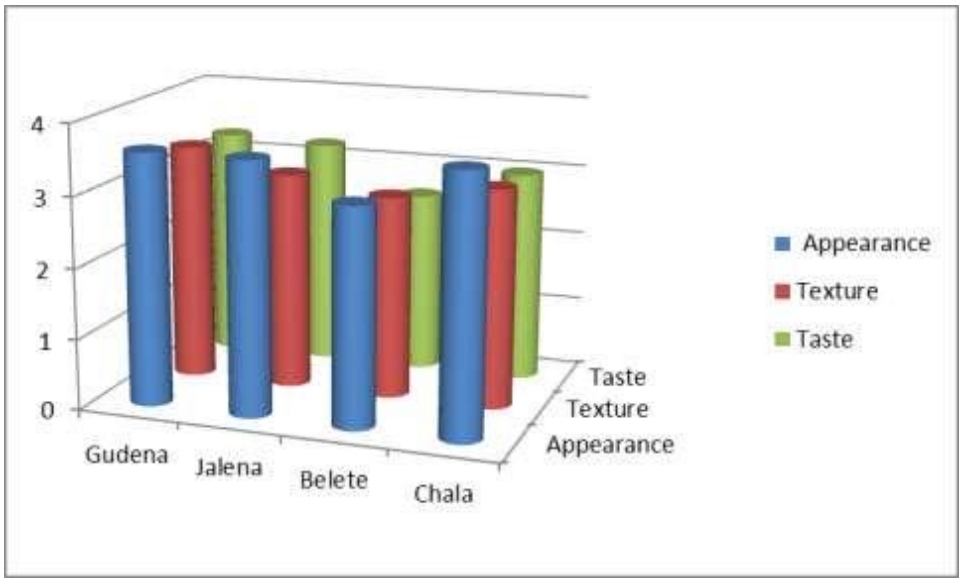

Fig 2. Sensory results of potato chips using Five point hedonic Scale

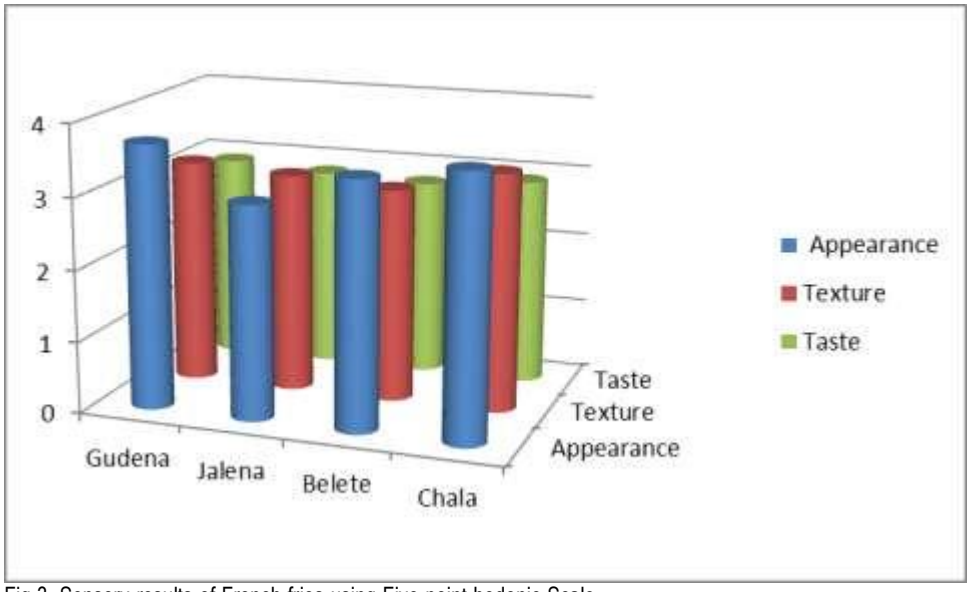

Fig 3. Sensory results of French fries using Five point hedonic Scale

Conclusions

The present study investigated nutritional compositions and sensory qualities of popular potato varieties in central highlands of Ethiopia. All the potato varieties had good nutritional composition and fell within acceptable limits, indicating that the varieties can potentially be utilized in the processed form to fulfill the daily requirement of nutrients.

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