Effect of farmers storage method on the quality and nutritional composition of potato in Holeta, Ethiopia

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Abstract
One of the constraints to the potential of potato is it's perish ability after harvest. This problem is due to lack of suitable storage methods. This study intended to evaluate storability of potato variety (Gudena) and to assess the effectiveness of selected storage methods under Ethiopian condition. Three storage methods were investigated with 100kg of fresh potato. The storage methods were ground pit, Dark house and field storage. Results obtained from this study showed that ground pit were more preferable where as in field and in dark house storage were less preferable due to physiological change in five month storage time. Ash content were significantly ($p<0.05$) different among storage methods from 5.2% to 6.02%.Texture and over all acceptability in fried and boiled form of potato significantly affect acceptability of potato in all storage methods. Taste and color in fried form of potato not significantly ($p<0.05$) affect acceptability of potato in storage methods and storage time. Ground pit storage was more preferable in all aspects physiological, nutritional and sensory acceptances.

Key word: *storage, nutrient and sensory*

Introduction

Potato is a versatile, carbohydrate rich food highly popular worldwide and prepared and served in a variety of ways. Freshly harvested, 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. Potatoes are rich in several micronutrients, especially vitamin C eaten with its skin; a single medium sized potato of 150 g provides nearly half the daily adult requirement (100 mg). Potato is a moderate source of iron, and its high vitamin C content promotes iron absorption. It 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.

The potato has a wide consumption and use field is required to be short or long term stored within the periods when there is no potato production. The potato tubers are

living creatures that make respiratory even after the harvest. Therefore they may substantially lose their weights and qualities by being subjected to matter loss during the respiratory. It leads to weight and nutritional losses along the storage period that the potato tubers have high moisture content and metabolic activity (Gottschalkand and Ezhekiel, 2006). These losses are mostly resulted from respiratory, transpiration and sprout development (Burton et al., 1992). The sprout development increases weight loss, shrinkage and the toxic alkaloid accumulation and tuber texture, hardness and nutritive value had been decreasing (Sorce et al., 2005; Delaplace et al., 2008).

In case the dehydration exceeds 5% during long storage of potatoes, significant changes occur at their qualities due to excessive withering and mellowing (Smith 1952; Joiner and Mackey, 1962; Sparks, 1965; Burton, 1966; Schippers, 1971). Burton (1966) stated that a weight loss at 0.15% occurs within the timeframe of last a few months of long storage period. Schippers (1971) stated that the losses of tuber weights showed a linear increase as the storage period increases. The storage of potato tubers at low temperatures (2-4 °C) indicates that offshoot development has been prevented for a long period and the sugar accumulation adversely affecting the chips quality has increased (Daniels-Lake and Prange, 2007; Kumar et al., 2007).Therefore the study aimed at investigating the possible changes in nutritional composition of potatoes during storage from different storage methods.

Materials and Methods

Farmer storage methods in potato production areas in west and north Shewa districts (Welmera, Jeldu and Degem districts) were assessed and three storage methods practiced by farmers but the popular storage method was field storage according to the farmers response. Gudena variety was used for this experiment in the Mian season of 2011/2013 E.C. Sample was collected after maturity and used for Quality and nutritional analysis. The result of fresh harvest sample was used as reference for Quality and nutritional content comparison for the different storage method. Three storage methods were used for the experimentation.

The treatments were set up as follow

Treatment 1: storage in ground pit- with alternate layers of grass and finally covered with soil.

Treatment 2: In field storage -stored in the farm until the rainy season.

Treatment 3: In dark house stored in closed room with only one door

After setting up the potato in the various storage methods and data was collected every month

Nutrient analysis

Moisture content

five gram of ground sample in a clean dry moisture crucible were placed in oven at 105oc for three hour and the sample were allowed to cool in a desiccators to maintain the sample temperature to room temperature for 30 minute.

MC = Weight before −Weight after ∗100 /Total weight

Total protein –kjeldhal method

One gram ground sample measured and transferred into completely dry kjeldhal flask. Ten gram of kjeldhal tablet was added to the sample inside the flask. Twenty milliliter of 98% concentrated sulphuric acid was mixed with the sample. The sample digestion was started by connecting the kjeldhal flasks with the digestion rock (2000 FoodALYT SBS). And the digestion was completed when the brown color of the sample was completely disappeared. After the digested sample was cooled, 250 ml of distilled water and 70 ml of sodium hydroxide (32%) were added and distilled into 25ml of excess boric acid containing 0.5ml of screened indicator. The distillate was titrated with 0.1N hydrochloric acid to the red end point.

$Total$ (%) = T−B ∗0.1401/ W ,

W is weight of the sample taken for analysis

T is volume of HCl used for titration

B is blank used as control

Crude protein (CP%) = N*6.25

Fat Content

Three gram of dry sample was weighed to in an extraction thimble; it was placed in the extraction unit. The flask was connected to hexane containing at 2/3 of total volume to the extractor until 6 hours. When finished, the hexane was evaporated by distillation or in a Rota evaporator. The flasks were cooled in a dryer and weighed.

% oil = weight of sample – weight of residue after extraction x 100/ Weight of sample

Ash Content

Three gram of dry sample was weighed out into the crucible, after the crucible has been heated and weighed and was placed in a temperature controlled furnace at 550oC for about 3hours for proper ashing. The crucible was then cooled in desiccators and immediately weighed.

% Ash = weight of ash remaining x 100 /Weight of original sample

Result and Discussion

Table 1 Physical change of stored potato at different time interval and different storage type

Storage type	month	October	November	December	January	February	march
Ground pit	Shape	N	N	N	N	N	Changed
	weight	N	N	N	N	N	lose
	Color	N	N	N	N	N	N
	germination	N	N	N	N	N	sprout
Infield	Shape	N	N	N	N	change	change
	weight	N	N	N	N	lose	lose
	Color	N	N	N	N	N	N
	germination	N	N	N	N	sprout	sprout
Dark house	Shape	N	N	N	N	change	change
	weight	N	N	N	N	lose	lose
	Color	N	N	N	N	N	N
	germination	N	N	N	N	sprout	

N =stands for Normal

Table 2. Nutrient content result in different time interval

	Nutrient			
Month	Protein	Fat	ash	MC
1.October(harvest)	6.83±0.02	0.65±0.07	5.20±0.28b	9.0±1.4
2.November	6.54±01.1	0.56±0.30	5.80±0.30ab	9.38±091
3.December	7.11±1.0	0.71±.23	5.86±0.30a	8.01±0.95
4.January	6.5±1.0	2.63±0.07	5.60±0.17a	8.66±.48
5.February	6.53±0.69	0.70±.29	6.03±0.32a	8.5±.40

Table 3. Nutrient content of potato result in different storage methods

Storage type	Nutrient			
	Protein	Fat	ash	MC
1. data during Harvesting	6.83±0.02	.65±.02	5.2±0.28a	9±1.4
2.infield	6.4±0.63	.67±.31	6.02±0.2ab	8.7±1.2
3.groundpit	7.5±0.86	.71±.2	5.9±0.26bc	8.7±.86
4. darkhouse	6.27±0.92	.58±.26	5.5±0.14c	8.5±.23

Table 4 .Sensory result of potato in different time interval

	Sensory data for crisp				Sensory data for boiled potato			
Month	taste	color	texture	Over all acceptality	taste	color	texture	Over all acceptality
1.October	4.5±0.7	4.5±0.70	4.00±0.0ab	4.5±0.7a	5±0.00a	4.5±0.7a	4.5±0.7a	5±0.00a
2.November	4.0±0.63	4.3±0.81	3.3±0.51bc	3.5±0.54b	3.0±0.63bc	3.5±0.5ab	3.5±0.5ab	3.33±0.51b
3.December	3.6±0.51	4.00±0.00	3.0±0.00c	4.0±0.0ab	3.83±0.98abc	3.5±0.83ab	3.16±0.75bc	3.5±0.54b
4.January	4.1±0.75	5.00±0.00	4.6±0.51a	4.8±0.4a	4.3±0.51ab	4.5±0.5a	4±0.00ab	4±0.00b
5.Februay	4.16±0.4	3.83±1.1	3.66±0.5bc	3.5±0.54b	2.5±0.83c	2.6±0.9b	2.1±0.4c	3.5±0.54b

Table 5. Sensory result of potato in different storage methods

	Sensory data for crisp				Sensory data for boiled potato			
Month	taste	color	texture	Over all acceptality	taste	color	texture	Over all acceptality
1. Harvesting	4.12±0.35	4.25±0.7	3.7±0.88	3.8±0.64	3.5±0.92	3.75±1.0	3.25±0.88	3.5±0.53b
2.infield	4.12±0.64	4.4±0.7	3.62±0.72	4±0.75	3.37±1.3	3.5±0.92	3.25±0.8	3.87±0.35b
3.groundp	3.75±0.70	4.2±1.0	3.62±0.7	4±0.75	3.37±0.9	3.37±0.9	3.12±0.8	3.37±0.5b

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4. dark house	4.12±0.35	4.5±0.70	4±0.00	4.5±0.7	5±0.00	4.5±0.7	4.5±0.7	5±0.00a

Physiological changes: Dark house storage and infield storage were more physiological change was observed especially in weight lose and sprout. Ground pit storage method was superior in preserving the physiological change which keeps from sprouting and fresh more than in field and dark house storage methods. This finding were in agreement with reports by (Sandifolo *et al.,* 1999)

Chemical change: Results of chemical analysis of crude protein, fat, ash and moisture content shown in (table 2 and 3) the storage methods differed significantly ($p<0.05$) in preserving the ash content. Protein, fat and moisture content were not differed significantly both on effect of storage methods and storage time (table 2,3). While the ash content was significantly ($p<0.05$) higher in all storage methods and storage time (table 2, 3).

Acceptability of stored potato: Results of sensory evaluation shown in (table 4,5). Texture and over all acceptability in fried and boiled form of potato significantly affect acceptability of potato in all storage methods. Taste and color in fried form of potato not significantly ($p<0.05$) affect acceptability of potato in storage methods and storage time (table 4, 5). This finding in agreement with (mbeza et al, 1996). In ground pit and dark house storage were more acceptable in fried and boiled form of potato shown in (table 4, 5).

Conclusion

The physical change of stored potato at different time and different storage type the weight lose and color change were observed more on infield storage and in dark house storage . Ground pit storage was good storage method which was not more physical change was not observed. Regarding to the nutrient content the ash content were changed with the time interval and the moisture content were decrease when the time interval change. Regarding to the sensory data in dark house and ground pit stored methods was more acceptable and fresh. So ground pit storage was more preferable in all aspect physiological, nutritional and sensory acceptances.

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