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Effect of Cassava Variety and Blending Ratio on the Proximate Composition and Sensory Acceptability of Cassava – Teff Injera

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Abstract
This study was initiated with the objective of investigating the possibilities of mixing cassava flour with teff for the production of injera. The experiments were carried out in a complete randomized design that comprised of two cassava varieties (Kello and Quelle) and three blending ratios (10, 20 and 30%) consisting of a total of 6 treatments and 1 control injera sample of 100% teff with three replications. Data were analyzed by SAS (version 9.1.3) and chemical analyses were done using standard methods. Cassava variety and blending ratio had significant ($P<0.05$) effect on proximate and sensory properties of the cassava-teff injera. With increasing cassava proportions from 10 to 30%, blended products exhibited reduction in ash from 2.86 to 2.27%, protein content from 9.7 to 7.78%, crude fiber from 2.37 to 1.71%, and crude fat from 1.85 to 1.66%. On the other hand, increasing the cassava proportion from 10 to 30%, showed an increment in moisture content from 61.03 to 64.29% and carbohydrate content from 83.22 to 86.59%. With increase in the proportion of cassava in the composite flour sensory acceptability of composite injera in a scale of 7 points with values decreased from 5.93 to 4.41 color, from 6.34 to 5.13 texture, from 6.13 to 4.74 taste, from5.81 to 4.94 sourness, from 6.45 to 5.34 rollability, from 6.33 to 4.82 injera eyes and from 6.22 to 5.03 overall acceptability. It is concluded that teff injeras produced by mixing with up to 30% cassava were found acceptable by consumers.
Keywords: Cassava-teff injera, Blending ratio, proximate composition and cassava variety

1. Introduction

Eragrostis teff (*Zucc.*) Trotter is a member of the Eragrosteae, belonging to Family Poaceae (Graminae) and sub-family Eragrostoidae (Stallknecht *et al*., 1993). It is an indigenous cereal crop in Ethiopia. Ethiopia is the origin and the first domesticator of this unique crop (Vavilov, 1951).

In Ethiopia, *teff* is cultivated on an area of about 2.73 million hectares and covered about 22.6% of the total grain crop area (CSA, 2012) making it the first among cereals in the country in area coverage. Furthermore, out of the total cereal grain produced, *teff* accounted for 16% (3.498 million tons) (CSA, 2012).

Teff is considered to have an excellent amino acid composition, with lysine levels higher than wheat or barley, as well as very high calcium, phosphorous, iron, copper, aluminum, barium, and thiamine (Mengesha, 1966).

The principal use of *teff* grain for human food is the Ethiopian bread (*injera*). *Injera* is a major food staple, and provides approximately two thirds of the diet in Ethiopia (Stewart and Getachew, 1962). It can also be used in many other food products such as *kitta* (unleavened bread), anebaberro (double layered injera), porridge, gruel, and local alcoholic beverages such as *tella* and *katikala* (Hailu *et al*., 2003). *Teff* protein essentially lacks gluten, the type found in wheat, so it is alternative food for consumers who suffer from wheat gluten allergies (Hopman *et al*., 2008). The grain proteins are also presumed easily digestible because prolamins are very small (Twidwell *et al*., 2002).

Teff is currently the most expensive grain to purchase in Ethiopia, because *injera* made of *teff* is the favorite diet of the citizens and usually considered as a prestige in the community and also *teff* flour is exported to USA. Besides this, the absence of gluten and its nutritional value made *teff* increasingly well-known and attractive in the United States, Europe and other regions and countries outside Ethiopia. Among the expanding segments of health-conscious consumers, *teff* is marketed by various sellers as a unique and healthy alternative to more common staples like wheat (BOSTID, 1996).

Cassava (*Manihot Esculenta Crantiz*) is the third largest source of carbohydrates in the tropics after rice and maize (Fauquet and Fargette, 1990). Cassava is a major staple food in the developing world providing a basic diet for over half a billion people (FAO, 1995). It is one of the most drought-tolerant crops capable of growing on marginal soils. Cassava root is essentially a carbohydrate source.

Traditional cassava utilization in most growing areas in Ethiopia is limited to boiling of fresh roots for consumption. In southern parts of Ethiopia, particularly in a place called Amarokelo, cassava is used as a staple food. In Wolaita and Arba Minch, cassava roots are widely consumed after washing and boiling or in the form of bread and 'injera' by mixing it with cereal crops.

Cassava is a poor source of protein as it contains only 1-3% protein on dry matter basis (Montagnac *et al*., 2009) and is low in essential amino acids such as methionine, lysine, tryptophan, phenylalanine and tyrosine (Falade and Akingbala, 2010). Due to this reason, a cassava-based diet requires supplementing with other sources to improve the nutritional status and prevent protein-energy malnutrition. Because teff has better amino acid composition with higher lysine level and better in iron content as compared to other cereals like barley and wheat, it is a good candidate to supplement cassava.

Despite this limited practice of mixing cereals with cassava for injera making there is little scientific research done on the characterization of teff-cassava composite injera to date. Therefore, initiation is taken to investigate the possibility of using cassava for injera production in combination with other cereals. Since, *teff injera* is consumed in Ethiopia as a major staple food, the incorporation of cassava with *teff* may enhance its use as staple food.

2. Materials and Methods

2.1 Experimental Site

Analysis of proximate composition and sensory evaluation of the product were carried out at Haramaya University.

2.2 Experimental Materials

The red *teff* (Eragrostis *teff*) grain (Variety/Dz-01-99) was collected from Debre Zeit Agricultural Research Center (DZARC) and the cassava (*Manihot Esculenta Crantiz*) varieties (Kello 44/72 and Quelle104/72) from Fedis Agricultural Research Center (FARC).

2.3 Experimental Design

The experiment was conducted in a 2×3 factorial experiment using CRD. The first factor was the cassava variety (V_1 and V_2) and the second factor was the blending ratios of cassava with *teff* flour which are 10, 20 and 30% cassava flour.

2.4 Cassava Flour Preparation

The cassava tubers were peeled manually using stainless steel knives. The peeled cassava tubers were washed and chopped manually with stainless steel knives, followed by drying in a Hot Air Oven Dryer at the temperature of 45^{o}C for 16 hr. The dried cassava chips were allowed to cool before being milled into flour using coffee grinder (Model NCG-940, Japan).

Finally, the milled cassava flour was sifted using sieves of aperture size of 710 µm and packed in polyethylene bags and store at 4^{O}C until required for analysis.

2.5 Preparation of *teff* flour

Teff grain was manually cleaned and milled by disk attrition mill traditionally used for *injera* processing at Haramaya University grain milling house. The flour was kept in air tight sealed plastic bucket at room temperature (AACC, 2000) for the duration of the analysis. The blend mixture was prepared for making injera.

2.6 Injera Making Procedures

Injera was baked as described by Bultosa and Taylor (2004). *Teff* and cassava composite flour was mixed with water (200 g flour + 180 ml water), dough was kneaded by hand to optimum consistency and after adding dry yeast (5% of flour) weight on the top of the dough. The dough was fermented at room temperature for 72 hr. After fermentation, 10 % of the fermented dough was mixed with water (1:3) and boiled for 4 min. The boiled batter then was cooled at temperature (46°C) and added back to the fermenting dough. After thorough mixing, the batter was fermented at room temperature for 2 hr and additional water was added to fermented dough to brought optimum batter consistency. Finally, fermented batter was poured in a circular manner on hot clay griddle, covered with lid to prevent steam from escaping, and baked for about 3 min.

2.7 Determination of Proximate Composition

The proximate compositions were determined according to AACC (2000). Carbohydrate was determined by subtracting the sum of other constituents from 100.

Percent carbohydrate = 100 – (% moisture content + % crude protein + % fiber + % crude fat + % ash)

2.8 Sensory Analysis

Panels of 50 members were selected from the staff, undergraduate and graduating class students of food technology and process engineering of Haramaya University, who have already taken sensory evaluation course. The sensory attributes; texture, taste, color, sour character, rollability, appearance, (i.e. eyes of *injera* and *injera* underneath appearance) and over all acceptability, was evaluated using a seven point hedonic scale.

2.9 Statistical Analysis

The analysis of variance (ANOVA) was used to test for significant variations between means of varieties and blends using appropriate software (SAS, version 9.1.3). The hedonic scores for the sensory evaluation were analyzed by ANOVA. All the data readings were done in triplicates and significance of differences were accepted at $P<0.05$.

3. Results and Discussions

3.1 Proximate composition of *teff* grain and cassava varieties

Table 1 shows the proximate composition of raw *teff* grain and the cassava varieties. Moisture contents of *teff*, Kello and Quelle flour were 10.5, 8.01 and 7.32%, respectively, showing significant (P<0.05) differences among the values. The moisture content of *teff* flour (10.5%) was significantly (P<0.05) higher than that of cassava flours. The moisture content of *teff* found in this study was lower than 11.83% reported by Sadik *et al*. (2013) and within the range of 9.30 to 11.22% found by Bultosa and Taylor (2004). The flour derived from Kello variety exhibited higher moisture content relative to the flour of Quelle variety. The moisture content of the cassava varieties found in this study within the range of 7.48 to 9.66% found in six cassava varieties by Emmanuel *et al*. (2012). Results showed that, moisture content of cassava varieties significantly lower than that of *teff* grain.

Ash contents of *teff*, Kello and Quelle were 3.11, 2.74 and 2.35%, respectively. The values indicated significant (P<0.05) differences among *teff* and cassava varieties. *Teff* flour had higher ash content than cassava flours. The ash content for *teff* grain was higher than the 2.52 and 2.80 % reported by Kebede *et al*. (2010) and Gebremariam *et al*. (2012), respectively. The ash content of *teff* grain was in close agreement within the value of 3.1 reported by Dejene *et al*. (2012). The ash content values of the cassava samples were statistically different (P<0.05) from each other (Table 2). The ash content for cassava varieties was higher than the 1.71 to 2.34% reported by Emmanuel *et al*. (2012) and agreed with the range of 1.3 to 2.8% found by Charles *et al.*(2005).

Crude fiber of *teff*, Kello and Quelle were 3.71, 2.52 and 2.95%, respectively. Crude fiber was observed to be significantly (P<0.05) higher in the *teff* grain than in cassava varieties. The crude fiber observed in the *teff* grain was within the range of 2.6 to 3.8% reported by Bultosa (2007). The crude fiber content findings for the two cassava varieties in this study was lower than 2.82 and 3.44% reported by Teka *et al*. (2013) for Kello and Quelle, respectively, and agree within the range of 0.1 to 3.7% reported by Salvador *et al*. (2014).

Table 1. Proximate composition *teff* and cassava flour

Variety	MC (%wb)	ASH (%db)	Crude protein (%db)	Crude fiber (%db)	Crude fat (%db)	Carbohydrate (%db)
Kello	8.01 ± 0.24^{b}	2.74 ± 0.18^{b}	2.21 ± 0.03^{c}	2.52 ± 0.07^{c}	1.5 ± 0.31^{ab}	91.03 ± 0.28^{a}
Quelle	7.32 ± 0.28^{c}	2.35 ± 0.12^{c}	3.24 ± 0.2^{b}	2.95 ± 0.26^{b}	1.31 ± 0.35^{b}	90.15 ± 0.38^{a}
Teff	10.5 ± 0.1^{a}	3.11 ± 0.15^{a}	10.76 ± 0.68^{a}	3.71 ± 0.15^{a}	2.47 ± 0.42^{a}	79.95 ± 0.75^{b}

Data are mean ± SD of triplicate analysis (%db) except moisture (%wb). Values in a column with the same letter are not significantly different (P>0.05).

The cassava varieties exhibited significant (P<0.05) difference between themselves in crude fat content with values of 1.31 and 1.5% for Kello and Quelle, respectively. However, these values were significantly (P<0.05) lower than the 2.47% found in the *teff*. The crude fat content of *teff* was within the range of 2.0 to 3.0 % reported by Bultosa (2007) and also in close agreement to the 2.5% reported by Gebremariam *et al*. (2012). The crude fat contents in cassava varieties were higher than the 0.58-1.04% found for three local cassava cultivars by Koko and Kouame (2014). The values were within the range of 0.74 to 1.49% reported by Emmanuel *et al*. (2012).

The data also showed that there were significant differences (p<0.05) in protein content among *teff* and cassava varieties. The protein content of the *teff* flour was higher (10.76%) than that of cassava flours which varied from 2.21 to 3.24% for Kello and Quelle cassava variety, respectively. This most probably is due to *teff* flour which contains higher protein content than cassava flour. The result obtained for *teff* was within the range of 8.7 to 11.1% reported by Bultosa (2007). The crude protein content of Quelle variety cassava flour was significantly higher than that of Kello flour sample. This may be due to difference in the rates of nitrogen metabolism in the growing plants resulting difference trends in crude protein content at the time of harvest. Kuzayil *et al.* (1996) reported that varietal differences in protein content may have been attributed to soil, climate, strain and fertilizer treatment. The crude protein content of cassava varieties were higher than 1.2 to 1.8% reported by Charles *et al.* (2005). The protein content of the cassava varieties were within the range of 1.17 to 3.48% reported by Emmanuel *et al*. (2012).

The carbohydrate content of the cassava flour varieties were in the range of 90.15 to 91.03%, significantly (P<0.05) higher than that of the *teff* flour (79.95%). The carbohydrate contents of the two cassava varieties did not show significant difference between them. The carbohydrate content of *teff* was higher than those values of 71.44 and 73.13% observed by Sadik *et al*. (2013) and Bultosa and Taylor (2004), respectively.

The carbohydrate content of cassava varieties was almost similar with the 91.76 and 90.55% found by Teka *et al*. (2013) for Kello and Quelle varieties, respectively.

3.2 Interaction effect of cassava varieties and blending ratios on proximate composition of cassava-teff injera

The proximate composition of *injera* made from cassava-teff blend is summarized in Table 2. The interaction of cassava varieties and the blending ratios exhibited significant effects in compositions of *injera* products. Moisture content varied significantly (P<0.05) with the highest value (64.82%) belonging to injeras of 30% Kello variety blended with *teff* followed by the 63.76% of 30% Quelle combined with *teff*. The lowest 60.6% was observed in injeras containing 10% Quelle variety. Results showed that moisture contents of all cassava-teff composite *injeras* were higher than that of the control (60.59%). So the moisture content of the blends were strongly influenced by the varieties and mix proportions. With increasing cassava proportions, the moisture content of the blend products was increased. This may be due to high moisture absorption of cassava as compared to *teff*.

Ash content of cassava-teff *injera* blends were significantly different (P<0.05) due to the interaction between blending ratios and cassava varieties (Table 6). The highest ash content (2.94%) was of the 10% blend of Kello with *teff*. The lowest (2.04%) value belonged to the blend of 30% Quelle variety due to lowest (2.35%) ash content of this variety as well as its high ratio in the blend. All the cassava-teff *injera* products exhibited lower ash content than that of the control (100% *teff* injera) because *teff* had higher ash content than the cassava varieties.

Similarly the interaction of varieties and blending ratios had significant effects (P<0.05) on crude protein content of cassava-teff *injera* (Table 2). The highest protein content (9.93%) was recorded for 10% Quelle variety blended with *teff*. This could be due to the relatively higher protein content of Quelle with respect to Kello variety and lowest blending ratios. The lowest crude protein content (7.47%) was of the blends 30% Kello with *teff*. The relatively lowest protein content (Table 1) of the variety must have influenced resulting in the lowest percentages of crude protein in the blends. Protein contents of all cassava-teff *injera* blends were lower than that of the control (10.49%). With the increased cassava proportion, the protein content of the blended cassava-teff *injera* was decreased due to higher protein content in *teff* as compared to cassava varieties.

Table 2. Effect of interaction between varieties and blending ratios on proximate composition of cassava-teff *injera*

Product	Moisture (%wb)	Ash (%db)	Crude Protein(%db)	Crude fiber (%db)	Crude fat (%db)	CHO (%db)
V1B1	61.46±0.87[de]	2.94±0.06[ab]	9.48±0.26[bc]	2.32±0.06[b]	1.88±0.03[b]	83.38±0.41[c]
V1B2	63.09±0.57[bc]	2.75±0.15[c]	8.55±0.11[de]	2.08±0.06[c]	1.75±0.01[cd]	84.87±0.32[b]
V1B3	64.82±0.81[a]	2.5±0.1[d]	7.47±0.19[f]	1.57±0.16[e]	1.67±0.07[ef]	86.8±0.18[a]
V2B1	60.6±0.47[e]	2.79±0.1b[bc]	9.93±0.18[ab]	2.41±0.11[b]	1.83±0.004[bc]	83.04±0.2[c]
V2B2	62.38±0.39[cd]	2.54±0.06[d]	9.13±0.11[cd]	2.23±0.05[bc]	1.73±0.03[de]	84.37±0.24[b]
V2B3	63.76±0.39[ab]	2.04±0.02[e]	8.09±0.1[ef]	1.85±0.16[d]	1.64±0.01[f]	86.38±0.27[a]
C	57.7±0.92[f]	3.07±0.16[a]	10.49±0.9[a]	2.66±0.1[a]	2.28±0.08[a]	81.5±0.76[d]
CV (%)	1.07	3.83	4.14	5.01	2.33	0.46

Data are mean ± SD of triplicate. Values in a column with the same letter are not significantly different (P>0.05). Note: V1= Kello, V2= Quelle, B1=10% cassava flour, B2= 20% cassava flour, B3= 30% cassava flour, C= Control sample (100% *teff injera*), CV= coefficient of variance, CHO= Carbohydrate.

Interaction of varieties and blending ratios had significant effect (P<0.05) on crude fiber content of the cassava-teff *injeras* (Table 2). The highest crude fiber content of the products were 2.41 and 2.32% of the blend of 10% Quelle (V2B1) and Kello (V1B1) variety with *teff*, respectively, but there was no significant difference (p>0.05) in crude fiber between the two variety products. The lowest value (1.57%) belonged to the blend V1B3 obtained from 30% Kello variety mixed with *teff*. Results showed that the fiber content of all cassava-teff *injera* was significantly lower as compared to control. When cassava ratio increased, the crude fiber content of the products decreased because of crude fiber content of *teff* was higher than that of cassava varieties.

The interaction between varieties and blending ratios had a significant effect (P<0.05) on crude fat content of the cassava-teff *injera* product (Table 2). The two highest crude fat contents (1.88 and 1.83%) were for Kello and Quelle at 10% blend with *teff*, respectively. The lowest crude fat was 1.64% for 30% Quelle (V2B3) variety mixed with *teff*. Crude fat content in the control was higher than that of the cassava-teff *injera* products due to higher crude fat in *teff* with respect to the cassava varieties.

The carbohydrate contents of cassava-teff *injera* products was also significantly affected (P<0.05) by the interaction of varieties and blending ratios (Table 2). The two highest carbohydrate contents (86.8 and 86.38%) were obtained in V1B3 and V2B3, respectively but there was no significant difference (p>0.05) between them. The two lowest (83.04 and 83.38%) with no significance difference between them were scored in V2B1and V1B1, respectively. The carbohydrate contents of all the cassava-teff *injeras* were significantly higher than that of the control (100% *teff* injera) because the two cassava varieties had higher carbohydrate content than *teff*.

3.3 Sensory Evaluation of Cassava-Teff *Injera*

Effect of cassava varieties and blending ratios on sensory acceptability of cassava-teff *injera*

The data of sensory acceptability tests of cassava-teff fresh *injeras* are presented in Table 3. The scores given to color acceptability were highest for *injeras* with 10% cassava mix, with values of 5.93 and 5.92 in a scale of 7 points, for Varieties Kello and Quelle, respectively. The scores decreased with increase in the cassava proportion. The color acceptability score of the control *injera* was 5.34.

The highest scores of texture acceptability was 6.34 and belonged to *injeras* containing 10% cassava of Kello. The values reduced as the percentage of cassava increased. Similarly the highest texture acceptability score for Quelle variety was 5.87 and decreased as the percentage of cassava increased. However the texture evaluation scores of all products were above 5 in the 7 point hedonic scale showing the acceptability of the products. The control sample scored 5.94 and this is the second highest score as compared to the blended *injeras* next to injera with 10% Kello. All the scores achieved remained above 5 in a scale of seven reflecting moderate liking and above.

Regarding acceptability of the taste, significant ($P<0.05$) differences were observed and the highest scores were obtained for injeras of the two varieties mixed with 10% cassava. The values were 6.13 and 5.88 for varieties Kello and Quelle, respectively. As the percentage of cassava increased, the scores for taste decreased in each case. The score of the control *injera* was 5.34. The taste acceptability scores of all the *injeras* in this study were between 4.74 and 6.13 in a scale of 7 points showing different levels of liking.

The scores for sourness of the *injeras* exhibited significant ($P<0.05$) differences. Highest values, 5.81 and 5.72, were of the samples with 20% Quelle and 10% Kello cassava mix. The lowest score, 4.94, for sourness belonged to samples with 30% Quelle cassava mixture. The value for the control was 5.67 and it was the third highest next to those with 20% Quelle and 10% Kello.

The interaction effects of varieties and blending ratios caused significant ($P<0.05$) differences on rollability. *Injeras* from both varieties mixed with 10% cassava exhibited the highest acceptability scores of 6.45 for variety Kello and 6.08 for variety Quelle. Rollability scores of *injera* decreased as the percentage of cassava increased for each variety. The control sample scored a value of 6.21 and this value is higher than the two varieties except for Kello variety at 10%. All the data indicated high degree of acceptability of the rollability attributes of the injeras with different levels of cassava mix.

The highest acceptability scores of the eyes of the *injeras* for the two varieties were 6.34 and 6.33 for varieties Quelle and Kello, respectively, with 10% cassava each with no significant ($P>0.05$) differences among them. The lowest two scores, 4.87 and 4.74, belonged to samples with 30% Quelle and Kello cassava blend, respectively. Generally, the trend showed that with increase in cassava proportion, the scores reduced. The score of the control sample, 6.02, was higher than the scores of samples with 20% and 30% cassava blend but lower than those mixed with 10% cassava.

Acceptability scores recorded for appearance of the back surface of the teff *injeras* were highest, (6.06 and 5.88), for those with 10% Kello and Quelle cassava blends. It appeared that increasing in the proportion of cassava affected the appearance of the back of the *injeras* reducing the scores given by the panelists. For each variety the scores for *injeras* 30% cassava were the lowest.

Finally the scores given to overall acceptability showed that *injeras* with 10% cassava received the highest scores of 6.22 and 6.14 for varieties of Kello and Quelle, respectively. The lowest scores were 5.33 and 5.03 for 30% cassava mix of Kello and Quelle Variety, respectively. The result showed that increasing cassava proportion lowered the overall acceptability of the injeras. All the scores indicated that all *teff injeras* mixed with cassava up to 30% received high level of acceptability.

Table 3. Effect of cassava varieties and blending ratios on sensory acceptability cassava-teff fresh *injera* product

Product	Color	Texture	Taste	Sour character	Rollability	Injera eyes	Injera underneath	Over all acceptability
V1B1	5.93 ± 0.02^a	6.34 ± 0.05^a	6.13 ± 0.02^a	5.72 ± 0.2^b	6.45 ± 0.04^a	6.33 ± 0.02^a	6.06 ± 0.06^a	6.22 ± 0.03^a
V1B2	5.54 ± 0.02^b	5.62 ± 0.02^d	5.54 ± 0.02^d	5.31 ± 0.12^e	5.87 ± 0.06^d	5.81 ± 0.02^c	5.54 ± 0.02^c	5.55 ± 0.08^c
V1B3	4.41 ± 0.02^f	5.13 ± 0.01^f	4.74 ± 0.01^g	5.21 ± 0.16^f	5.81 ± 0.02^e	4.74 ± 0.02^f	5.02 ± 0.04^e	5.33 ± 0.03^e
V2B1	5.92 ± 0.14^a	5.87 ± 0.01^c	5.88 ± 0.02^b	5.42 ± 0.02^d	6.08 ± 0.03^c	6.34 ± 0.01^a	5.88 ± 0.02^b	6.14 ± 0.02^b
V2B2	5.54 ± 0.02^d	5.47 ± 0.03^e	5.48 ± 0.07^e	5.81 ± 0.01^a	5.35 ± 0.01^f	5.55 ± 0.02^d	4.82 ± 0.02^g	5.26 ± 0.02^f
V2B3	4.46 ± 0.04^e	5.14 ± 0.02^f	5.27 ± 0.04^f	4.94 ± 0.01^g	5.34 ± 0.01^f	4.87 ± 0.01^e	4.94 ± 0.01^f	5.03 ± 0.06^g
C	5.34 ± 0.02^c	5.94 ± 0.02^b	5.61 ± 0.02^c	5.67 ± 0.02^c	6.21 ± 0.02^b	6.02 ± 0.1^b	5.41 ± 0.02^d	5.53 ± 0.04^d
CV (%)	2.37	0.45	0.63	1.96	0.53	0.73	0.59	0.79

Mean ± SD in a column with the same letter are not significantly different ($p>0.05$). Note: V1= Kello, V2= Quelle, B1 = 10% cassava flour, B2=20% cassava flour, B3=30% cassava flour, C=control sample (100% *teff injera*), for V1 and V2, respectively, CV =coefficient of variation.

4. Conclusions

- The current study showed that varieties and blending ratios had significant influence on proximate composition and sensory acceptability of cassava-teff *injera* product.

- Adding cassava to *teff* had significantly increased total carbohydrate content but decreased ash, crude protein, crude fiber and crude fat contents of the cassava-teff composite *injera*.
- The acceptability of color, texture, taste, rollability, eyes and underneath appearance and overall acceptability of cassava-teff *injera* reduced when cassava blending ratio was increased.
- Overall acceptability and the sensory attributes scores were higher for injeras with 10% Kello blend with *teff* as compared to all the rest of the injera products.
- *Teff* injeras produced by mixing with up to 30% cassava were found acceptable by consumers.

5. Recommendations

- Since injera is the national staple food for more than 70% of Ethiopians, cassava is advisable to be included in daily diet plan for the production of cassava-teff *injera*.
- It is advisable to study other mineral and vitamin components found in teff, cassava and cassava-teff *injera*.
- It is advisable to study shelf life, antioxidants, microbiology, physico-chemical, functional properties and antinutrients of cassava-teff *injera*.
- More study is needed to assess acceptability of the injeras with blending ratios higher than 30%.

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