Effect of Fenugreek Incorporation on Tef Injera Quality

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Abstract

Injera, pancake like- flat bread, is the most commonly consumed food product in Ethiopia. This study was conducted to determine the effect of fenugreek (raw, roasted and germinated) incorporation (1%, 3% and 5%) on nutritional composition, sensory quality and keeping quality tef injera. The result showed that injera enriched with 5% raw and roasted fenugreek showed the highest crude protein and crude fiber contents compared with control (100% tef flour).1% roasted fenugreek-substituted Injera exhibited the highest Fe (18.12 mg/100g) and Ca (65.77 ± 1.8 mg/100 g) contents. Injera made with 5% raw fenugreek had lowest microbial load, which had recorded significantly the highest shelf life (five days). Sensory evaluation (appearance, taste, aroma, texture and overall acceptability) done indicated that of all injera enriched incorporated with 1% fenugreek level were more preferable than that of maximum incorporation (5%). Furthermore, injera made with 5% raw fenugreek incorporation level had lower acceptability due to its bitterness. From this study, it can be concluded that 3% of fenugreek incorporation could give nutritionally enhanced and sensorially acceptable injera without compromising the keeping quality.

Kekwords: Fenugreek, Tef, Injera, sensory analysis, keeping quality

Introduction

Injera is the most commonly consumed food product in Ethiopia and Eretria. It accounts two –third of Ethiopian diet and two-third of the daily protein intake of the Ethiopian population. Injera is thin, fermented Ethiopian traditional bread made from tef flour, water, and starter (ersho), which is a fluid, saved from previously fermented dough. Tef *(Eragrostistef (zucc) trotter*) is the stable crop and most popular grain for making injera because it is good injera texture (soft and rollable), better consumer acceptance, and less staling property.

Contrary to the earlier practices the market for processed injera is increasing rapidly. This led to the proliferation of household level injera processors and small scale entrepreneurs. In addition, dry and fresh injera export market is increasing. Injera storage period does not usually exceed three days at ambient temperature under commonly stored condition due to mould growth and inadequate sensory acceptance (Ashagrie and Abate, 2012).Therefore, availing injera with better keeping quality and suitable handling mechanism is becoming important.

Fenugreek is also used in many parts of Middle-East, India, Mediterranean and Central Asian regions in the form of whole seeds, sprouted, powder, sauce or as paste used in a variety of savory dishes. . Fenugreek seeds are rich source of phytonutrients, minerals (Cu, K, Ca, Se, Zn, Mn and Mg) and vitamins. It contains the compounds (saponins, hemicelluloses, mucilage, tannin and pectin) help lower blood LDL-cholesterol levels by inhibiting bile salts re-absorption in the colon. They have been used orally for loss of appetite and stomach complaints. They also bind to toxins in the food and help to protect the colon mucus membrane from cancers. Fenugreek seeds have been used in many traditional medicines as a laxative, digestive, and as a remedy for cough and bronchitis. Fenugreek seeds added to cereals and wheat flour (bread) or made into gruel, given to the nursing mothers may increase breast milk production.

In some regions of Ethiopia, e.g. Wello, women usually prepare injera by adding some fenugreek flour to tef to improve its baking quality, get softer texture shiny appearance. Taddesse (1969) and Beyene (1965) suggested that fenugreek seed, which is rich in protein especially lysine, is a good supplement if used with tef for producing injera. According to these authors, such traditional practice is encouraged to continue The common practice of fenugreek incorporation is in the form of roasted (malted or unmalted) flour (Debrework, 2009). Bemihiretu (2013) observed enhanced the antioxidant activities in fenugreek incorporated injera with fenugreek at 95:5 ratio of tef flour to fenugreek, respectively. However, there is limited scientific information on the effect of incorporation of fenugreek on improving sensory quality and keeping quality of tef injera is limited. . The effect of fenugreek malting and the suitable level of incorporation for better injera sensorial and keeping quality are not yet determined. Therefore, this study, designed to evaluate the influence of the blend ratio and primary processing condition of fenugreek on injera sensory quality, nutritive value and keeping quality.

Materials and Methods

Raw material collection and preparation

The sample of the fenugreek (Chala variety) and tef (Quncho variety) were obtained from Debre Zeit Agricultural Research Center (DZARC). First, the whole samples of fenugreek were divided into three parts after cleaning. One part (M) was soaked in distil water for overnight and then transferred to other airtight container and was left for three days for malting. Then the malted fenugreek was dried in an oven at 60^0c. Fenugreek was prepared according to procedure of Atlaw and Yogesh (2015). Both the malted and one other part (RO) were roasted separately until changed to deep brown color. Then all malted (M), Roasted (RO) and the other part (RW) were milled with miller and packed into separate polyethylene bags. The tef samples were cleaned and ground by using miller and

the prepared flour was sieved through 1mm sieve. All fenugreek flour were mixed with tef flour after milling at 1%, 3%, and 5 %of each sample type and packed in polyethylene bags for later injera making and lab analysis.

Preparation of injera

The tef injera was prepared in the traditional way as it is baked in individual households. Accordingly, the tef flour was fixed with clean water in the ratio of 1:2 (w/w) and 10% of starter culture (ersho) by the weight of the flour and was kneaded by hand in a bowl. The resultant dough allowed for fermentation for 3 days at ambient temperature. After this primary fermentation, the surface water formed on the top of the dough discarded. The main dough was thinned by adding water equal to the original weight of the flour and stirred for 15 minutes. After that, the batter was covered and left for 2 hours for the second fermentation. Then, the absit was added to the thinned dough and mixed very well. The batter was left for about 30 minutes to rise (the second fermentation), before baking started. Finally, about half a liter of batter was poured onto the hot clay griddle in a circular motion from the outside, working towards the Center. After 2-3 minutes of cooking using traditional baking equipment (metad), the injera was removed and stored in a traditional basket container messob (Ashagrie and Abate, 2012).

Biochemical compositional analysis

Injera prepared was used for analysis of protein, fiber, mineral analysis, sensory acceptability, and shelf life determination. Samples were taken from each injera enriched with fenugreek & the control. Crude protein, total ashes, crude fat, crude fiber, moisture and minerals (Ca, P, Fe, Zn) determination was done as procedures of AOAC (2000) official methods of food analysis. Carbohydrate content was found by difference method (FAO, 2003). Energy content was obtained as 4*Carbohydrate + 4*Protein + 9*Fat.

Keeping quality determination

The injera samples were examined for visible signs of mould growth on the crust every day. The microbial infestation was defined as the period in days during which the spoilage caused by microorganisms was first observed. The shelf life was expressed in relation to the corresponding control (Katsinis *et al*, 2008) as cited by Ashagrie and Abate (2012).

Sensory evaluation

The appearance, taste, color, aroma and overall acceptability were analyzed. Twenty untrained but experienced panelists were selected from the staff members. All the samples (control and treatment) were presented for them on the same trays. Five point hedonic test (5-like very much, 4- like, 3-niether like nor dislike, 2-dislike, and1-dislike very much) was used.

Statistical analysis

Data were analyzed by analysis of variance using general Linear Model procedure of SAS software (SAS institute, 2002). Differences among means with $p<0.05$ were accepted as statistically significant differences. Duncan multiple comparisons were used to separate means.

Results and Discussion

Proximate composition

The nutritional compositions of fenugreek and tef grains are presented in Table 2. Compared to tef, the seeds of fenugreek

has higher carbohydrate than that of fenugreek. The increased fenugreek substitution showed lower carbohydrate content of *Injera*. The energy contents of all fenugreek substituted *Injera* were significantly ($p<0.05$) increased as compared to control. This could be due to fenugreek has higher fat than that of tef. The increased fenugreek substitution showed higher energy content of *Injera*.

Table 2: Nutritional compositions (g/100g) and energy (KCal/100g) contents of fenugreek incorporates injera

Formulation	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate	Energy
Control	4.90±0.23^{a}	2.63±0.04^{ab}	9.97±0.09^{c}	1.27±0.09^{e}	3.97± 0.26	77.38±0.45^{a}	360.52±2.19^{b}
RO1%	4.97±0.04^{a}	2.50±0.09^{b}	10.23±0.08^{bc}	1.7± 0.11^{abcd}	4.23±0.30^{a}	76.42±0.16^{ab}	361.65±2.26^{ab}
M1%	4.47±0.15^{bc}	2.60±0.09^{ab}	10.03±0.09^{c}	1.43±0.04^{de}	5.00±0.87^{a}	76.46±0.69^{ab}	360.78±2.69^{b}
RW1%	4.23±0.14^{cd}	2.60±0.02^{ab}	10.10±0.04^{c}	1.43±0.06^{de}	4.93±0.33^{a}	76.72±0.52^{ab}	360.20±1.65^{ab}
RO3%	4.70±0.00^{ab}	2.73± 0.03^{a}	10.43±0.23^{abc}	1.73±0.10^{abc}	4.00±0.43^{a}	76.39±0.28^{ab}	363.04±1.27^{ab}
M3%	4.63±0.05^{ab}	2.63±0.02^{ab}	10.10±0.07^{c}	1.60±0.06^{bcd}	5.32±0.03^{a}	75.80±005^{b}	358.12±0.51^{b}
RW3%	4.43±0.03^{bc}	2.67± 0.01^{a}	10.17±0.03^{bc}	1.50±0.01^{cde}	5.03±0.22^{a}	76.26±0.24^{ab}	359.02±0.95^{b}
RO5%	4.00±0.05^{de}	2.73± 0.05^{a}	10.80±0.51^{ab}	1.70±0.10^{abcd}	4.33±0.43^{a}	76.61±0.74^{a}	364.66±1.27^{a}
M5%	4.43±0.1^{bc}	2.67± 0.02^{a}	10.63±0.09^{abc}	1.90±0.12^{a}	4.13±0.39^{a}	76.27±0.32^{ab}	364.64±1.30^{a}
RW5%	3.87±0.03^{e}	2.67±0.04^{a}	11.00±0.25^{a}	1.80±0.10^{ab}	5.07±55^{a}	75.60±0.92^{b}	362.67±2.21^{ab}
CV	4.09	3.02	3.38	9.09	16.34	1.161	0.841

The result were interpreted as Mean ± SE, treatments that share the same letters are not significantly different . RW, RO and M respectively represent raw, roasted and malted fenugreek flour. Kcal=kilocalories

Mineral composition

The addition of fenugreek flour had a significant effect on mineral composition of injera. The highest calcium (Ca) content was recorded for injera incorporated with 5% roasted fenugreek flour (65.77mg/100g) followed by 3% roasted fenugreek flour (60.33mg/100g) and 5% malted fenugreek (57.20mg/100g) (Table 3). As the fenugreek incorporation increase, the calcium content of the composite injera increased and this could be due to higher Ca content of fenugreek than tef (Tewderos *et al.*, 2013 and Kassaye, 2015).

The highest Zn content was obtained in injera with 5% roasted fenugreek flour (2.77mg/100g) and the 5% raw fenugreek (2.70mg/100g) while that of the check was 2.00mg/100g. The result also showed that increasing the level of fenugreek increased increased Zn content of Injera and this could be because of higher Zn content of fenugreek (Tewderos *et al.*, 2013) than tef. Injera enriched with 5% roasted fenugreek flour had the highest Fe content (18.12 mg/100g) followed by 3% roasted (17.83 mg/100g). Melaku (1966) reported that the Fe contents of two tef varieties as 19.60mg/100g and 11.5mg/100g. The Injera enriched with 5% roasted fenugreek flour also had the highest phosphorus contents (192.90mg/100g) as compared with the control (147.90mg/100g) and the 5% malted fenugreek flour (146.60mg/100g) incorporated one. However, compared to the check the phosphorus content of the injeras incorporated with malt fenugreek did not show significant ($p>0.05$) with the check.

Table 3: Injera mineral composition (mg/100g) and keeping quality (in days)

Run (formulation)	Ca	Zn	Fe	P	Keeping quality
Control (0%)	49.87±2.23^{c}	2.00±0.12^{b}	16.73±0.37^{a}	147.90±1.92^{e}	3.00±0.00^{d}
RO1%	56.10±3.40^{bc}	2.27±0.08^{ab}	17.83±0.59^{a}	184.79±7.10^{ab}	3.00±0.00^{d}
M1%	52.83±0.76^{bc}	2.10±0.05b	17.46±0.32^{a}	145.29±8.33^{e}	2.00±0.00^{e}
RW1%	54.43±2.10^{bc}	2.23±0.09^{ab}	17.24±0.35^{a}	155.00±13.2^{cde}	3.33±0.33^{cd}
RO3%	60.33±0.83^{ab}	2.77±0.37^{a}	17.12±2.03^{a}	188.00±3.33.^{ab}	3.67±0.33^{bc}
M3%	56.00±3.58^{bc}	2.20±0.06^{ab}	15.40±0.25^{a}	148.89±4.21^{de}	2.00±0.00^{e}
RW3%	52.13±3.38^{bc}	2.30±0.15^{ab}	17.08±0.38^{a}	171.53±3.09^{abc}	4.00±0.00^{b}
RO5%	65.77±0.75^{a}	2.47±0.18^{ab}	18.53±1.78^{a}	192.59±11.82^{a}	3.00±0.00^{d}
M5%	57.20±3.87^{abc}	2.47±0.20^{ab}	17.42±1.24^{a}	146.60±4.81^{e}	2.00±0.00^{e}
RW5%	53.10±3.93$^{b±c}$	2.70±0.20^{a}	17.03±1.01^{a}	170.45±7.12^{bcd}	5.00±0.00^{a}
CV	8.67	12.95	2.827	7.807	8.323

The results mean ± SD Treatments that share the same letters are not significantly different (p≤0.05gm). Ca=Calcium, Zn=Zink, Fe= Iron, P=Phosphorus; RW, RO and M respectively represent raw, roasted and malted fenugreek flour.

Injera keeping quality

The result recorded for injera made with 5% raw fenugreek flour has the highest keeping quality (five days) followed by injera enriched with 3% fenugreek powder (four days) and they were significantly different (p≤0.05) from each other. The injera samples enriched with malted fenugreek powder (1%, 2%, and 5%) were found to decrease the average keeping quality of normal injera (3 days) to two days. This could be due tothe activated enzyme during germination (malting) and degradation of polymers to disaccharides and monosaccharide, which are easily available to support microbial growth.

Table 4: Sensory acceptance of fenugreek incorporated injera

Injera	Color	Appearance	Taste	Aroma	Texture	OAA
Control (0%)	4.10 ±0.15^{a}	3.7 ±0.11^{b}	3.20 ±0.14^{d}	2.90 ±0.15^{b}	3.80 ±0.14^{c}	3.60 ± 0.11^{b}
M1%	4.25 ±0.15^{a}	4.35 ±0.13^{a}	4.45 ±0.17^{ab}	4.30 ±0.14^{a}	4.50 ±0.14^{a}	4.55 ±0.11^{a}
RO1%	4.15 ±0.19^{a}	4.40 ±0.13^{a}	4.10 ±0.18^{b}	4.40 ±0.11^{a}	4.05 ±012^{abc}	4.40 ±0.15^{a}
RW1%	4.15 ±0.17^{a}	4.40 ±0.22^{a}	3.90 ±0.22^{bc}	4.65 ±0.18^{a}	4.05 ±0.19^{abc}	4.35 ±0.22^{a}
M3%	4.45 ±0.16^{a}	4.35 ±0.15^{a}	4.45 ± 0.10^{ab}	4.50 ±0.13^{a}	4.30 ±0.14^{ab}	4.45 ±0.13^{a}
RO3%	4.20±0.17^{a}	4.50 ±0.20^{a}	4.75 ±0.13^{a}	4.55 ±0.15^{a}	3.95 ±0.13^{bc}	4.60 ±0.17^{a}
RW3%	4.50 ±0.21^{a}	4.50 ±0.17^{a}	4.10 ±0.17^{b}	4.60 ±0.17^{a}	4.10 ±0.18^{abc}	4.40 ±0.18^{a}
M5%	4.35 ±0.16^{a}	4.50 ±0.18^{a}	4.45 ±0.23^{ab}	4.45 ±0.15^{a}	4.35 ±0.16^{ab}	4.50 ±0.15^{a}
RO5%	4.25 ±0.15^{a}	4.50 ±0.18^{a}	4.40 ±0.20^{ab}	4.70 ±0.18^{a}	4.20 ±0.19^{abc}	4.55 ±0.15^{a}
RW5%	4.45 ±0.12^{a}	4.50 ±0.15^{a}	3.50 ±0.19^{cd}	4.65 ±0.15^{a}	4.00 ±0.12^{bc}	4.45 ±0.14^{a}
CV	17.19	17.08	19.00	15.38	16.37	15.92

The result are mean ± SE, treatments that share the same letters are not significantly different (p≤0.05); OAA= Overall acceptance;RW, RO and M respectively represent raw, roasted and malted fenugreek flour.

Sensory evaluation

Sensorial evaluation showed that fenugreek incorporation did not significantly (p>0.05) affect injera color and aroma (Table 4). However, fenugreek incorporation significantly (p<0.05) improved the appearance the injera samples.

The injera with malted fenugreek flour had a more acceptable texture than those with raw and roasted fenugreek flours and the check. This could be due to the activated enzymes in the malted fenugreek flour.

Despite the improvements observed in other sensorial aspects due to the incorporation of raw fenugreek flours at 5% had deleterious effect on the test (bitterness), while the incorporation of roasted and malted fenugreek flours at 5% had a more or less acceptable test. The result also revealed the improvement of injera acceptability due to the incorporation of fenugreek powder.

Conclusion and Recommendation

From this study, it can be concluded that incorporation of fenugreek in to tef flour could improve the nutritional, color, texture, appearance and keeping quality of tef injera. However, it is better to limit incorporation level to 3% to get injera with acceptable test.

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