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Effect of Blending, Soaking and Roasting of Fava bean, Fenugreek and Lentil on Physicochemical and Sensory Acceptability of 'Hilbet'

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Abstract
Hilbet` is a special type of traditional fasting fava bean sauce food particularly well known and used in the northern Ethiopian. It is foam prepared from lightly roasted and soaked fava bean, fenugreek lentil grains, milled and sifted into fine flour called *Hilbet* flour‟. The aim of this study to evaluate the effect of blending, soaking and roasting of fava bean, fenugreek and lentil on physicochemical and sensory acceptability of "Hilbet" products were evaluated. The processing methods were soaking and roasting (S and R) of fava bean, fenugreek and lentil. The proportions are SB1 (73FB:14LE:13FG), SB2 (80FB:7LE:13FG), SB3 (87FB:13FG), RB1 (73FB:14LE:13FG), RB2 (80FB:7LE:13FG) and RB3 (87FB:13FG) for this 2x3 factorial design was used. The products were analyzed for their major nutrient contents such as moisture, ash, crude fiber, protein, fat, carbohydrate, gross energy and minerals. Sensory evaluation was conducted for evaluating of colour, taste, flavour, texture and overall acceptability. The moisture content of SB3 was the highest observed. The SB1 showed the highest in fiber and carbohydrate, whereas the RB3 was the highest in fat and gross energy. The RB1 showed the highest in protein content, ash, Ca, Mg, Fe and Cu, whereas Zn was the highest in SB2. The soaked Hilbet product showed best overall acceptability than roasted product.
Keywords: Blending, Soaking, Roasting, Fava bean, Fenugreek, Lentil, Physicochemical and Hilbet .
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1. Introduction

Hilbet` is a special type of traditional fasting fava bean sauce food particularly well known and used in the northern Ethiopian. It is also used in the fava bean growing areas of the Tigray region. It is foam prepared from lightly roasted and soaked fava bean, fenugreek lentil grains, milled and sifted into fine flour called *Hilbet* flour‟. *Hilbet* flour is a ready to eat product and suitable for preparing fast foods within a short time. Most of the time the peoples called favourite vegan food whipped `*Hilbet*` and at fasting time eaten with stew and injera most common in Tigray. It is widely used for long time traditionally and `*Hilbet*` foam initially eaten with hand mixer until it become frothy. Culturally, in the central zone of Tigray, wedding ceremonies without *Hilbet* is impossible on fasting time and thus enough *Hilbet* food must be prepared from fava bean, fenugreek and lentil for all invited guests on the wedding day. This shows the importance of fava bean, fenugreek and lentil on such special ceremonies and served on other cultural ceremonies as a special dish all are personal information's.

Pulses are among major staple crops in Ethiopia. Chickpea (*Cicer arietinum L.*) and fava bean (*Vicia fava L.*) are widely produced and consumed in the country as staple diets but also grown as cash crops for the farming communities as they are among the high value export commodities in the country (Teferra *et al.,* 2015).They are among the four major food legumes produced in Ethiopia (FAOSTAT, 2008).These major crops are distributed in the lower and upper highlands of the country as described by Teferra *et al.* (2015).

Pulses are different from the leguminous oilseeds, which are primarily utilized for oil (Tharanathan and Mahadevamma, 2003). Pulses are a good source of protein, carbohydrates, dietary fiber, minerals, vitamins, and phytochemicals required for human health (Boye *et al*., 2010a; Kaur and Singh, 2007a). At present, pulses are grown and consumed all over the world and occupy an important place in human nutrition, especially in those countries in which the consumption of animal protein is limited by no or low availability, religious beliefs or cultural habits. Their nutritional characteristics have been associated with a reduction in the incidence of various cancers, LDL cholesterol, type-2 diabetes and heart disease (Bassett *et al*., 2010; Roy *et al*., 2010).

Processing techniques are important to reduce cooking fuel and long holding time requirements (Joshi *et al.,* 2010); reduce levels of anti-nutritional constituents such as trypsin inhibitors, phytic acid and tannins (Wang *et al.,* 2009; Khandelwal *et al.,* 2010). On the other hand there is a globally growing interest in processing and applying the pulses as ingredients in processed ready to-serve food products (Alvarez *et al.,* 2014).

Soaking results in the reduction of the mineral contents of pulses, due to the loss in the soaking water, especially when the water is discarded; however, their bioavailability is increased after soaking (Martín Cabrejas *et al*., 2009). The increase in the bioavailability of minerals may be attributed to the reduction in anti-nutritional factors during soaking like tannin, phytic and trypsin. These anti-nutritional factors are known to bind to the minerals in legumes, making them unavailable to the human body (Martín-Cabrejas *et al.*, 2009).

Roasting can affect the nutrients present in legume seeds where the complex protein, carbohydrate and fat could be broken down into peptides or amino acids, simple sugars and 3 fatty acids, respectively, increase the availability of nutrients (Kavitha and Parimalavalli , 2014; Olanipekun *et al.*, 2015). Besides, roasting may also promote Maillard reactions, which will lead to the formation of antioxidants (Thidarat *et al,* 2016).

The food processing industry is increasingly interested in the potential to incorporate ingredients, such as pulses, in to food products for nutritional purposes, including their high protein and fiber content, gluten free status, low glycemic index, antioxidant levels, as well as functional properties like protein solubility and foaming properties. Health and nutrition present an enormous opportunity for the legume sector (Alvarez *et al.,* 2014). Because of animal proteins being more expensive for low-income people in developing countries, the legumes and their products are alternative source for protein nutrition in this case. Moreover, searching for new and valuable sources of protein to nutritionally supplement traditional food has led to an increasing interest in the use of legume seeds (Martinez-Villaluenge *et al.,* 2009)**.**

2. Materials and Methods

2.1. Sample Collection and Preparation

Local variety of fava bean (*Vicia favae. L.*), fenugreek (*Trigonella foenum - graecum L.*) and lentil (*Lens culinaris*) were collected from Axum Agricultural Research Centre (AARC). Ginger, garlic and ruta were purchased from local market at Axum city. The pulses and ingredient samples were collected and transported in a polyethylene bag from Axum, a place from Hawassa more than 1000km faraway. The pulses and ingredients sample were packed and transported in a polyethylene bag system and public transport vehicle to Hawassa College of Agriculture, School of Nutrition, Food Science and Technology Laboratory and Animal Nutrition Laboratory, Hawassa University until analysis and processed in to *Hilbet* sauce products.

2.2 Experimental design

The experiment was made in 2x3 completely randomized design (CRD) which has two factors, processing methods at two levels and blending ratio at three levels (fava bean and lentil) **.** Independent variables are blending proportions of fava bean (FB), lentil (LE) and fenugreek (FG) (73:14: 13; 80:7:13 and 87:0:13) and processing methods (soaking and roasting). All results were carried out at least in duplicate. Dependent variables were proximate compositions (moisture content, crude fibre, crude protein, total ash, total carbohydrate content, gross energy, calcium, magnesium, iron, zinc and copper), physic-chemical properties (viscosity, titratable acidity and pH), and sensory acceptability.

Table 1: Treatments and Experimental design table

Sample Code	Blending Proportion	Soaking	Roasting
RB1	FB1:LE1:FG1	-	✓
SB1	FB1:LE1:FG1	✓	-
RB2	FB2:LE2:FG2	-	✓
SB2	FB2:LE2:FG2	✓	-
RB3	FB3:LE3:FG3	-	✓
SB3	FB3:LE3:FG3	✓	-

Where R: roasted; S: soaked; RB1; 73 Fava bean +14 Lentil +13 (Fenugreek + ingredients)
RB2; 80 Fava bean + 7 Lentil + 13 (Fenugreek + ingredients)
RB3; 87 Fava bean + 0 Lentil + 13 (Fenugreek + ingredients)
SB1; 73 Fava bean + 14 Lentil +13 (Fenugreek + ingredients)
SB2; 80 Fava bean + 7 Lentil + 13 (Fenugreek +ingredients)
SB3; 87 Fava bean + 0 lentil+ 13 (Fenugreek + ingredients)
B3; 87 Fava bean + 13 (Fenugreek + ingredients) was used as control source from community.

2.3 Preparation of fava bean, lentil and fenugreek using soaking method

After removing or cleaning unwanted materials, seeds of fava bean, lentil, and fenugreek were soaked at the same time in separate contained in tap water for 24 hours at room temperature (water was changed every 6 h). A seeds / water ratio of 1:5 (w/v) was used. After soaking, the water was discarded. The soaked seeds were washed twice with tap water followed by rinsing with distilled water. The seeds were dried in shadow sun light for 7-14 days.

2.4 Preparation of fava bean, lentil and fenugreek using roasting method

One kg of the pulse seeds was moistened with 150 mL of tap water. The moistened seeds were left to equilibrate for 15 min. The seeds were roasted by electric fryer at 120 oC for 5min 27 (lentil), 120 oC for 7min (fenugreek) and 150 oC for 10 min (fava bean) while the seeds were continuously turned until colour changed to brown (Fasoyiro *et al.,* 2010).

2.5 Milling processes

After the dried fava bean and lentil seeds were initially dehulled by grinder and the seed coat was winnowed from the seeds. Then the skins of fava bean and lentil were easily removed manually but the fenugreek skin not removed. After that the fava bean, lentil and fenugreek seeds were milled and the flour was sieved with 710 µm sieve size. Finally, the Fava bean and lentil flours were mixed with fenugreek flour in different proportions (Table 1). The flour was packed using a polyethylene bag and kept at 4 °C until analysis and products developed.

2.6 Preparation of `Hilbet` products

Hilbet was prepared according to traditional method. *Hilbet* flour (100g) was mixed with cold water (500mL) (1:5, w/v) and little amount of boiled water was added. The mixture was transferred to stainless-steel container containing boiled water and cooked at 80 oC for 30-45 min by continuous steering. Then small amount of cold water was added on top and let it for 1-5 min and it was stirred. After processed the mixture was kept at 4 oC for 2-3 hours. The `*Hilbet*` foam was initially beaten with hand mixer (whipping blender or electrical mixer) until it became frothy. Small amount water was added and beaten continually until it became soft when a bubble stood straight without bended. Finally, the mixture powder was prepared from table salt (300g), ginger (50g), garlic (100g) and leaf of ruta (25g). Then 50g of mixture powder was added to each *Hilbet* sauce products.

2.7. Physicochemical Analysis

Proximate compositions like moisture content and total ash content were analyzed using AOAC (2005). Crude fat were analyzed using AOAC (2011) and crude fiber and crude protein were analyzed using standard method (AOAC, 2000). Carbohydrate contents were determined by differences. Gross energy was determined by AOAC (2005) calculation from, Atwater's conversion factor, 16.7 kJ/g (4kcal/g) for protein, 37.4 kJ/g (9 kcal/g) for fat and 16.7 kJ/g (4 kcal/g) for carbohydrates and expressed in calories. 1Kcal = 4.18 kJ/100g. The mineral contents (Ca, Mg, Ze, Cu and Fe) were determined by the procedure of AOAC (2005) using an Atomic Absorption Spectrophotometer.

2.8. Sensory Evaluation

Sensory analysis was conducted at Hawassa University FSPT Laboratory. Organoleptic parameters such as colour, appearance, flavour, taste, texture (mouth feel) and overall acceptability were key measures of product quality were conducted according to Gomiero *et al.* (2003). A total of 29 panelists were selected from *Hilbet* traditional sauce consumer. The consumers level sensory evaluation as untrained panellists. For those panellists was given training about sensory evaluation. The panellists were provided with a mouth rinse in between each tasted. Judgments were made through rating products on a 9 point Hedonic Scale with corresponding descriptive terms ranging from 9 "like extremely" to 1 "dislike extremely", according to the method described by Meilgard *et al.* (2007) to find out the most suitable treatment for *Hilbet* production.

2.9. Statistical Analysis

The statistical analyses of the data were performed using Statistical Analysis System (SAS, Version 9.1). The results were expressed as the mean values ± standard deviation. The data were subjected to two-way analysis of variance (ANOVA) and the mean separation values were determined using Fischer LSD multiple comparison test to determine least significant differences ($p < 0.05$) between mean values within each group.

3. Results and Discussion

3.1 Effect of blending, soaking and roasting on proximate composition of Hilbet

The moisture contents of *Hilbet* sauce products were ranged from 30.32 to 27.03 % (Table 2). The moisture content of *Hilbet* sauce product was highest value found in SB3 and moisture content was lowest value found in RB1. The moisture content of soaked *Hilbet* products were higher ($p < 0.05$) compared to the roasted *Hilbet* products. But similar among roasted RB1, RB2 and RB3 samples and also similar ($p > 0.05$) found among soaked SB2, SB1 and SB3 samples (Table 2). Moreover, moisture content was higher amounts in soaked *Hilbet* sauce than roasted *Hilbet* sauce products. This may be due to hygroscopic character of soaked *Hilbet* Flours ability to interact with water. The low level of moisture in roasted flours is due to high temperature which eliminates water more quickly and the intermolecular cross-linking that might occur. Similar findings were reported by Aurelie *et al*., (2017); Baik and Han (2012) and Mueen *et al*. (2009) on chickpeas, lentils, peas, and soybeans for fortification food.

The maximum ash content (2.94g/100g) was observed of *Hilbet* sauce product RB1 which was 14% lentil flour substituted fava bean flour and the ash content value was lower observed in SR3 product. The ash contents of *Hilbet* sauce products results indicated that were higher ($p < 0.05$) among all *Hilbet* sauce products showed (Table 2). The ash content of soaked *Hilbet* sauce products were lower ($p < 0.05$) compared to the roasted *Hilbet* sauce products. The ash content of SB2, SB1 and SB3 were similar among the products, between RB1 and RB2 products and also between RB2 and RB3 products. No similar ($p < 0.05$) among RB1 and RB3 the products (Table 2). The increment of ash content was followed the same pattern as that of the moisture content because of increasing the lentil level content. Similar results were reported on blended bean biscuit making (Adebowale, 2012 and Lee *et al.,* 2007)). The ash content of roasted *Hilbet* products was significantly higher ($p < 0.05$) than that of soaked *Hilbet* products. This result agreed with different reports on roast legume had the highest ash contents than soak, because, this could probably be greater loss of minerals due to soaking (Ramırez-Cardenas *et al.*; 2008 and Pujola *et al.,* 2007).

The fibre content of *Hilbet* products ranged from 2.74 to 3.98g/100g. The fibre content was highest in soaked *Hilbet* product SB1 and the result was lowest on roasted *Hilbet* product RB3, respectively. The fibre content of soaked *Hilbet* sauce products results were higher ($p < 0.05$) compared to the roasted *Hilbet* sauce products and also they were significantly different ($p < 0.05$) among SB1, RB1 and SB2 products. They were similar ($p > 0.05$) among SB3, RB3 and RB2 products (Table2). This result was similar with the study conducted on soaked legume (Kutos *et al.*, 2003) and reported on breaking of bonds between the polysaccharide chains on roasted legumes (Onyeike *et al*., 2015) but not similar with reported by Anigo *et al.* (2010) and Mugendi *et al.*(2010) on complementary food prepared from legumes products. This difference may be due to the blended proportion, processed and added ingredients in *Hilbet* sauce products. The crude fibre content of *Hilbet* sauce products increased from RB3 to RB1 and SB3 to SB1. When level of lentil flour increased the amount of fibre content also increased in all products. Similar finding was reported on the fibre content of lentil higher than that of fava bean flour (Ladjal and Chibane, 2015).

The protein content of *Hilbet* sauce product was highest value found in RB1 while the protein content was lower found to be in SB3 as 22.59 - 19.60g/100g (Table 2). The protein content of soaked *Hilbet* sauce product results were higher ($p < 0.05$) compared to the roasted *Hilbet* sauce products. They were similar ($p > 0.05$) in between RB3 and RB2 products, between RB3 and SB1 products and also between SB2 and SB3 products. There were not similar ($p < 0.05$) among RB1, RB3 and SB1 (Table2). The protein content was increased from RB3 to RB1 and SB3 to SB1 in both roasted and soaked products. When the amount of lentil increased the protein content also increased. This may be due to the protein content of lentil flour was not affected. Similar result was obtained on soaking and roasting lentils (Rehman and Shah, 2005) but the protein content of fava bean was affected by soaking and roasting (Siah *et al.*, 2014). The protein content of *Hilbet* sauce products ranged from 22.59 up to 19.60 g/100g. Similar results were reported on roasted legumes for bread quality by Hu, (2003) and Seena *et al.* (2006). In this study, the protein content of roasted *Hilbet* was higher than that of the soaked product. This may be due to high soluble protein found in fava bean when soaked in water. This finding agreed with different reported on fava bean and cowpea (Aurelie *et al*., 2017 and Oboh *et al*., 2010).

The highest value of crude fat content was found in RB3 in which lentil flour was supplemented at a level of 0% substitution of fava bean flour. The fat content was lower found in SB1 sample. The statistical results presented in Table 2, indicated that the crude fat contents of *Hilbet* sauce products were not significant affects ($p > 0.05$) among all blended and processed products, might be the same fat content at the addition of fava bean and lentil flour and also may not be different on soaked and roasted processed affected the products. High crude fat amount was also indicated in all roasted *Hilbet* products than soaked *Hilbet* products.

May be the heat-induced destruction of cell structure and the efficient release of oil reserve could be the reasons of inclined level of fat content, especially, in fava bean. Increase in fat content of the *Hilbet* sauce was also important because fat increases the energy density of the *Hilbet* sauce, provides essential fatty acids and facilitates the absorption of fat-soluble vitamins. Similar reported by Oboh *et al.* (2010) an increase in oil content after roasting has been reported on cereal seeds like maize and also soaking induced increase in the lipid content on soybean flour reported by Aurelie *et al.* (2017). The crude fat contents of *Hilbet* sauce products were not significantly affected by blending proportion and processing methods ($p > 0.05$). This might be due to the same fat content was in fava bean and lentil flours. This result disagreed with reported on fat content of lentil flour higher than that of fava bean (Baik and Han, 2012). Similar result was reported by Aurelie *et al*. (2017) the fat content of soybean flours the same after roasted and soaked. The high fat content on *Hilbet* sauce was observed, this result was disagreed with reported by Baik and Han (2012) on chickpeas, lentils, peas, and soybeans for fortification food.

The carbohydrate content of *Hilbet* sauce products was ranged from 33.01 to 31.06gm/100g. In result of carbohydrate was highest in soaked *Hilbet* product SB1 which accounted 33.01 ± 0.48g/100g and the result was lowest on roasted *Hilbet* product RB1 which accounted 31.06 ± 0.0.28g/100g, respectively. The carbohydrate content of *Hilbet* sauce products results were revealed that not significant effect ($p > 0.05$) among all products presented blended ratio and processed. This result was higher than study conducted in soybean flour as affected by roasting and soaking from 22.8 ± 1.6 to 27.9 ± 1.8 g/100 g, but the total carbohydrate content did not vary significantly with soaking or roasting reported by (Aurelie *et al*., 2017).

The result Hilbet sauce products gross energy contents in this study were in the range of 313.72 to 346.77 kcal per 100 g. On average basis soaked Hilbet sauce product was the highest amount in SB3 product and roasted Hilbet sauce products was the highest amount in RB3 followed by RB2 products, respectively. The result of gross energy content on soaked Hilbet sauce products were lower ($p < 0.05$) compared to the roasted Hilbet sauce products. They were not similar ($p < 0.05$) between RB3 and SB1 products but they were similar ($p > 0.05$) found among RB2, RB1, SB3 and SB2 products showed in (Table 2). The results of gross energy contents in all Hilbet sauce products above 310kcal/100g were observed. According to Walker (1991) the recommended daily allowance of energy for complementary foods in developing countries ranged from 370 up to 420 kcal /100 g. So that the result of our studded lower than the recommended which mean can satisfy lower than minimum energy requirements. This result disagreed with reported by Mishra V *et al*. (2012) on soya bean blended cookies (392.88 up to 446.9 kcal /100 g) but agreed with reported by Ofuya and Akhidue (2006) on fava bean (320 kcal/100 g).

Table 2. Effect of blending, soaking and roasting on proximate composition of *Hilbet*

Samples code	Moisture Content (%)	Ash (g/100g)	Fiber (g/100g)	Protein (g/100g)	Fat (g/100g)	CHO (g/100g)	Gross Energy (kcal/100g)
SB1	29.52 ±0.40^{a}	1.83±0.07^{c}	3.98±0.05^{a}	20.77± 0.2^{bc}	10.9±2.94^{a}	33.01±4.46^{a}	313.72±8.00^{b}
SB2	29.75 ±0.31^{a}	1.74±0.3^{c}	3.27±0.03^{c}	20.34±0.37^{cd}	11.92±2.9^{a}	32.98±0.42^{a}	320.59±5.94^{ab}
SB3	30.32±0.42^{a}	1.71±0.1^{c}	2.77±0.04^{d}	19.60±0.43^{d}	13.07±1.4^{a}	32.53±2.32^{a}	326.17±5.30^{ab}
RB1	27.03 ±0.04^{b}	2.94±0.2^{a}	3.75±0.03^{b}	22.59±0.5^{a}	11.12±1.3^{a}	32.57±2.62^{a}	320.12±3.22^{ab}
RB2	27.15 ±0.21^{b}	2.54±0.4^{ab}	2.8±0.00^{d}	22.24±0.13^{a}	13.25±1.1^{a}	32.02±2.81^{a}	336.29±0.95^{ab}
RB3	27.30 ±0.42^{b}	2.38±0.1^{b}	2.74±0.01^{d}	21.23±0.18^{b}	15.29±1.0^{a}	31.06±1.68^{a}	346.77±1.32^{a}

NB: SB1 (Soaked fava bean 73g +soaked lentil 14g + fenugreek 13g),SB2 (soaked fava bean 80g + soaked lentil 7g + soaked fenugreek 13g), SB3(soaked fava bean 87g +soaked fenugreek 13g), RB1(roasted fava bean 73g + roasted lentil 14g + roasted fenugreek 13g), RB2(roasted fava bean 80g+roasted lentil 7g + roasted fenugreek 13g), RB3(roasted fava bean 87g + roasted fenugreek 13g). Values within the same column with different superscript letters are significantly different at $p<0.05$, values are presented as mean + standard deviation

3.2 Effect of Processing and Blending Ratio on Mineral Composition of Hilbet

Mineral content of *Hilbet* sauce products are presented in (Table 3). The statistical results are indicated that the high amount of calcium content on roasted RB1 and the lowest contended on soaked SB1. The calcium contents showed significant different ($p < 0.05$) was found among RB1, RB3, RB2, SB2 and SB3 samples but similar ($p > 0.05$) in between SB3 and SB1. Blended and processed of *Hilbet* sauce products by the addition of fava bean and lentil flour was higher ($p < 0.05$) in between roasted and soaked sauce *Hilbet*. This difference may be due to waste the soaking water. Comparatively lower contents of minerals when soaked in water might be due to leaching out of some minerals into the soaking water. Similar findings were reported on roasted and soaked common bean (Oliveira *et al.,* 2008; Ramırez-Cardenas *et al.,* 2008). However, soaking improved the availability of all the minerals.

The statistical results are presented in Table 3 indicated that the highest amount of magnesium content at RB1 and the lowest at SB3. The magnesium contents showed significant difference ($p < 0.05$) was found between RB1,RB2,SB1,SB2 and RB3 samples but similar ($p > 0.05$) in between RB3 and SB3 samples. These amounts were significantly different ($p < 0.05$) with both blending proportion and processing (soaked and roasted) differences maybe the soaked water discards. Similar result was reported on white bean when the soaking water discards (Elmaki *et al*., 2007).

Table 3. Effect of blending, soaking and roasting on proximate composition of *Hilbet*

Samples	Calcium (mg/100g)	Magnesium (mg/100g)	Iron (mg/100g)	Zinc (mg/100g)	Copper (mg/100g)
SB1	10.75±0.14^{e}	2.377±0.021^{c}	2.011±0.042^{e}	1.522±0.038^{b}	0.046±0.015^{c}
SB2	11.46±0.09^{d}	2.208±0.028^{d}	3.457±0.185^{c}	1.744±0.060^{a}	0.060±0.014^{c}
SB3	11.02±0.13^{e}	2.115±0.023^{e}	3.809±0.075^{b}	1.121±0.077^{d}	0.162±0.008^{ab}
RB1	13.13±0.33^{a}	2.678±0.033^{a}	4.089±0.021^{a}	1.08±0.068^{de}	0.180±0.023^{a}
RB2	11.98±0.17^{c}	2.523±0.008^{b}	3.641±0.065^{b}	1.281±0.037^{c}	0.139±0.020^{b}
RB3	12.72±0.14^{b}	2.157±0.038^{e}	3.089±0.112^{d}	0.999±0.045^{e}	0.006±0.002^{d}

NB: SB1 (Soaked fava bean 73g + soaked lentil 14g + fenugreek 13g),SB2 (soaked fava bean 80g + soaked lentil 7g + soaked fenugreek 13g), SB3(soaked fava bean 87g + soaked fenugreek 13g), RB1(roasted fava bean 73g + roasted lentil 14g + roasted fenugreek 13g), RB2(roasted fava bean 80g + roasted lentil 7g + roasted fenugreek 13g), RB3(roasted fava bean 87g + roasted fenugreek 13g). Values within the same column with different superscript letters are significantly different at p<0.05, values are presented as mean + standard deviation.

The statistical results are presented in Table 3 indicated that the higher iron content on roasted *Hilbet* sauce products RB1 which was value 4.089 ± 0.021mg/100g and soaked *Hilbet* sauce product SB1 contained the lowest iron content value 2.011 ± 0.042mg/100g on dry weight basis. The iron contents were higher ($p < 0.05$) in between RB1, RB2, SB2, RB3 and SB1 samples but similar ($p > 0.05$) in between SB3 and RB2 samples. *Hilbet* products prepared from soaked and roasted flour of fava bean, lentil and fenugreek proportional. The results were significant differences ($p < 0.05$) in between soaked and roasted *Hilbet* sauce products with respect to its blending proportions. This difference may be due to the loss of iron during soaking. Similar findings were reported (Martín Cabrejas *et al*., 2009; Beruk Berhanu , 2013; Luo and Xie , 2014). The iron content of the present study was lower than the RDA (7 mg/100 g) reported by Ramırez-Cardenas *et al*. (2008) and Pujola *et al.* (2007) on common bean but similar findings were seen in Nigerian on „furra", soya bean mixed complementary food and soaked chickpea bean (Pujola *et al.*, 2007; Oliveira *et al.*, 2008).

The statistical results presented in Table 3 indicated that the zinc content of all *Hilbet* sauce products ranged from 0.999 to 1.744 mg/100 g. The zinc contents were higher ($p < 0.05$) in 50 among SB2, SB1, RB2, SB3 and RB1 samples but similar ($p > 0.05$) in between RB1 and RB3 samples. Zinc content of soaked *Hilbet* products were higher ($p < 0.05$) compared to the roasted *Hilbet* products. Similar finding was reported by Olayiwola *et al*. (2012) on Cocoyam-based recipes enriched with cowpea flour but not similar finding was reported by Aurelie *et al*. (2017) on soya bean and sorghum, when roasting time was increased the amount of zinc also increased.
The statistical results presented in Table 3 indicated that the higher scored in RB1 and lowest scored in RB3 which was ranged from 0.18 to 0.006 mg/100 g. The copper contents were higher ($p < 0.05$) in between RB1, RB2, SB2 and RB3 samples but they were similar ($p > 0.05$) in between RB1 and SB3, SB1 and SB2, SB3 and RB2 samples. When observed the amount of copper content was very low in all *Hilbet* sauce products. Similar finding was obtained a great loss of copper on roasting and soaking beans (Huma *et al.* 2008).

3.3 Effect of blending, soaking and roasting on sensory quality of Hilbet sauce

The results of sensory evaluation attributes of *Hilbet* sauce products are presented in (Table 11), colour preferences were in the range of 6.55 to 8.14(between liked moderately and liked very much). The highest colour preferences in SB2 was found value 8.14 ± 0.74, liked very much by panellists and lowest colour preferences in RB3 was found value 6.55 ± 1.06, liked moderately by panelists. The result of colour soaked *Hilbet* products were higher ($p < 0.05$) compared to the roasted *Hilbet* products .They were similar ($p > 0.05$) between roasted RB1, RB2 and RB3 products and also similar ($p > 0.05$) were found between soaked SB2, SB1 and SB3 products. The colour of roasted *Hilbet* sauce products were decreased preference than soaked *Hilbet* sauce products by panelists.

The appearance of *Hilbet* sauce product was observed range from 6.57 to 7.72 (between liked moderately and liked very much) the high preference was on soaked blended of SB2 and the lowest on roasted RB3. The appearance preference of soaked *Hilbet* sauce products were increased than roasted *Hilbet* sauce products by panellists. The tastes of soaked *Hilbet* sauce products were higher ($p < 0.05$) compared to the roasted *Hilbet* sauce products. There was similar ($p > 0.05$) among SB2, SB1 and SB3 samples and also between RB1 and RB3 samples and between RB1 and RB2 samples but not similar ($p < 0.05$) in appearance preference among SB2, RB3 and RB2 samples by panelists.

Table 4. Effect of blending, soaking and roasting on sensory quality of Hilbet sauce

Samples code	Colour	Appearance	Flavour	Texture	Taste	Overall acceptability
SB1	7.98±0.78^{a}	7.62±1.24^{ab}	6.81±1.18^{b}	7.21±1.31^{ab}	7.55±1.23^{a}	7.59±1.23^{a}
SB2	8.14±0.74^{a}	7.72±1.24^{a}	6.69±1.14^{b}	7.50±1.39^{a}	7.72±1.18^{a}	7.69±1.03^{a}
SB3	7.95±0.96^{a}	7.60±1.12^{ab}	6.64±1.28^{b}	7.52±1.26^{a}	7.67±1.33^{a}	7.67±1.03^{a}
RB1	6.67±1.10^{b}	6.88±1.08^{cd}	7.60±1.23^{a}	6.53±1.20^{c}	6.86±1.18^{b}	6.66±1.29^{b}
RB2	6.55±1.16^{b}	7.16±2.76^{bc}	7.59±1.14^{a}	6.91±1.19^{bc}	6.97±1.14^{b}	6.95±1.16^{b}
RB3	6.55±1.06^{b}	6.57±1.03^{d}	7.53±1.26^{a}	6.83±1.19^{bc}	6.67±1.26^{b}	6.78±1.17^{b}

NB: SB1 (Soaked fava bean 73g + soaked lentil 14g + soaked fenugreek 13g),SB2 (soaked fava bean 80g + soaked lentil 7g + soaked fenugreek 13g), SB3(soaked fava bean 87g+soaked fenugreek 13g), RB1(roasted fava bean 73g + roasted lentil 14g + roasted fenugreek 13g), RB2(roasted fava bean 80g + roasted lentil 7g + roasted fenugreek 13g), RB3(roasted fava bean 87g +roasted fenugreek 13g). Values within the same column with different superscript letters are significantly different at p<0.05, values are presented as mean + standard deviation.

The flavour of *Hilbet* sauce products ranged from 6.64 to 7.60 (between liked moderately and liked very much). The flavour preference of roasted *Hilbet* sauce products were increased than soaked *Hilbet* sauce products by panellists. The flavour acceptance of roasted *Hilbet* sauce products was higher results from soaked *Hilbet* sauce products ($p > 0.05$). There was similar ($p > 0.05$) in flavour among SB1, SB2 and SB3 samples. Similarly, the flavour preferences were similar ($p > 0.05$) among RB3, RB2 and RB1 samples but these values were higher ($p < 0.05$) compared to the SB1, SB2 and SB3 products (Table 11).

The taste performance of *Hilbet* sauce products ranged from 6.57 up to 7.72 (between liked moderately and liked very much) the high performance was observed on SB2 and the lowest on roasted RB3. There was similar ($p > 0.05$) in taste among RB2, RB1 and RB3 products and also the taste values were similar ($p > 0.05$) in among SB2, SB1 and SB3 products but these values were higher ($p < 0.05$) compared to the RB2, RB1 and RB3 products (Table 11).

that the taste of soaked *Hilbet* sauce products higher performance than roasted *Hilbet* sauce products by panellists.

The result overall acceptability of soaked *Hilbet* sauce products were higher ($p < 0.05$) compared to the roasted *Hilbet* sauce products. They were similar ($p < 0.05$) among SB2, SB1 and SB3 samples and also between SB2, SB1 and SB3 samples. The result of *Hilbet* sauce products higher overall acceptability was seen in soaked *Hilbet* sauce products than roasted *Hilbet* sauce products at laboratory level. In this study, the legumes cannot roast in order to improve organoleptic properties and acceptability of foods similar reported on legumes by (Muhimbula *et al.* 2011).

5. Conclusion

Based on the results obtained from experiments in the present study, the conclusions are set: The soaked and roasted *Hilbet* sauce products were rich in protein and fat but poor in carbohydrate and fibre. This sauce had high amount of Ca, Mg, Fe, Zn and Cu. The roasted *Hilbet* product had the highest Ca, Mg, Fe and Cu contents whereas, the Zn was highest in Soaked *Hilbet* sauce product. In addition, protein isolation of soaked *Hilbet* sauces was better than roasted products on protein solubility, foaming properties and gelation capacity. These functional properties, which affect the sensory characteristics of the products, play important roles in the physical behaviour of the food. Generally, increasing the amount of lentil improved fat, protein, zinc and iron contents. The TPC and antioxidant activities were general higher in roasted than *Hilbet* sauce products. It also indicated that phenolic compounds were the main contributors of antioxidant activities in *Hilbet*. The study revealed that *Hilbet* sauce products can be used as source of natural antioxidants which can useful for inclusion in the human diet for the formulation of therapeutic supplementary foods to improve overall nutritional status and for potential health benefits.

Therefore, awareness can be created regarding the underutilized *Hilbet* sauces as they are not consumed by most of the people in the country but have good nutritional profile and bioactive components. Therefore, the sensory acceptability, nutritional content and high antioxidant activities of *Hilbet* is an indicators for the utilization, and should be promoted to different parts of the country so that can be used not only during fasting periods but also as a regular meal.

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