

**TRADITIONAL FOOD PROCESSING PRACTICES OF OATS (*Avena sativa*)
AND ITS CONTRIBUTION TO FOOD SECURITY IN GOZAMIN DISTRICT
OF NORTHWEST ETHIOPIA**

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ABSTRACT

Oat is one of the cereal crops in Ethiopia, which is less recognized in terms of its food value and productivity. It is grown and utilized as a staple food only in a specific part of the country. The objective of this study was to assess the food significance of oat and document associated traditional food knowledge of the crop in Gozamin district, Northwest part of Ethiopia. Data were collected using a semi-structured questionnaire, focus group discussion and key informant interviews. Secondary data collected from Gozamin agriculture development offices and research centers were used to support our results. A total of 388 households participated in this cross-sectional study. Data were edited, coded, entered and analyzed using SPSS for windows version 20.0. The results of this study affirmed that 97.2% of the producers cultivated oat every year and high rainfall is the suitable weather condition for its production. As per the results of this study, oat is tolerant to acidic and marginally fertile soils where other plants do not grow and yield well. As compared to other conventional cereal crops, 85% of the participants of the study reported that the cultivation of oat does not require extensive farming and can be produced with minimum inputs. The entire population of respondents (100%) reported that oat grain was used as food. Almost all the respondents (99.2%) utilized oat as their staple crop for their families. Oat ranked first in terms of consumption at household level as compared to other cereal crops (*tef*, maize, wheat, and barley). In the district, oat is processed into different food types and beverages including *injera*, *kitta/anababiro*, gruel, porridge, *enket*, and local alcoholic drinks, *tella*. Oat is rarely used to prepare porridge and local alcoholic beverages as compared to other cereal-based staple food types. Porridge and local alcoholic beverages are commonly prepared for special occasions and on holidays. Oat is a less known crop in specific locations but could contribute to enhancing food diversity options to improve food and nutrition security efforts in the country.

Key words: Food Security, Oat, Oat Processing, Underutilized Crop, Traditional Foods



INTRODUCTION

Food security is the primary concern in Africa, as crop production and productivity are under continuous threat [1]. According to the Food and Agriculture Organization report, due to the *El Niño*-induced drought in 2015, 10.2 million people in Ethiopia were food insecure [2]. Tapping diversified food crops contributes to food security under the present trend of increasing population and changing climate [3, 4].

There are many known edible plants in the world. However, two-thirds of plant-derived food at the global level comes from three significant bowls of cereals namely, maize (*Zea mays*), wheat (*Triticum aestivum*) and rice (*Oryza sativa*) [5, 6]. Their increasing dominance has contributed to a decline in other crop species as potential food sources. Dependence on a few crops limits our capability to deal with adverse effects from food shortage and dietary imbalance. Many commonly consumed crops have hundreds or thousands of varieties, but only a small fraction of these varieties have scientific data available [7].

Oat (*Avena sativa*) is one of the less recognized and utilized cereal crops in Ethiopia. The crop does not require extensive farming, is produced in marginal soil, and is tolerant to insect pest attack and disease pressures compared to wheat and barley. The chaff is used as a cattle feed, and the grain is for food with excellent storage stability. However, the crop is grown and consumed only in five East Gojjam Zone districts, Northwest parts in Ethiopia. In other parts of the country, the crop is predominantly produced as feed for horses and farm animals. People in other parts of Ethiopia lack information about oat as human food and its processing practices. This unfamiliarity could be because of ethnic foods and their traditional processing cultures, which are limited to specific areas unless communicated and familiarized to other parts of the country.

Oat can broaden the food base and diversify the diet preference for cereal-based products. Due to its tolerance to acidic and eroded soil, it will be the future crop in the planet's ever-changing climate (climate-smart agriculture). The localized production and use of the crop only in five districts of Ethiopia might be associated with a lack of scientific information on food and nutritional values of the crop for human consumption [8]. The traditional knowledge and skills of processing and production of different food types from this underutilized crop also need to be studied and documented for further optimization and scale-up efforts. Therefore, this study assessed and explored the crop's significance and documented traditional knowledge of oat-based food processing practices in Gozamin district, Northwest part of Ethiopia.

MATERIALS AND METHODS

Study area

The study was carried out in Gozamin district located in East Gojjam Zone of the Amhara Regional State, Ethiopia (**Figure 1**). It is one of the 18 districts found in the Zone located at 10° 36' 18" N and 37° 55' 02" E with an altitudinal range of 1000-



3200 meter above sea level. The mean annual temperature ranged between 11 and 25°C, whereas the mean yearly rainfall was between 1448 and 1888 mm.

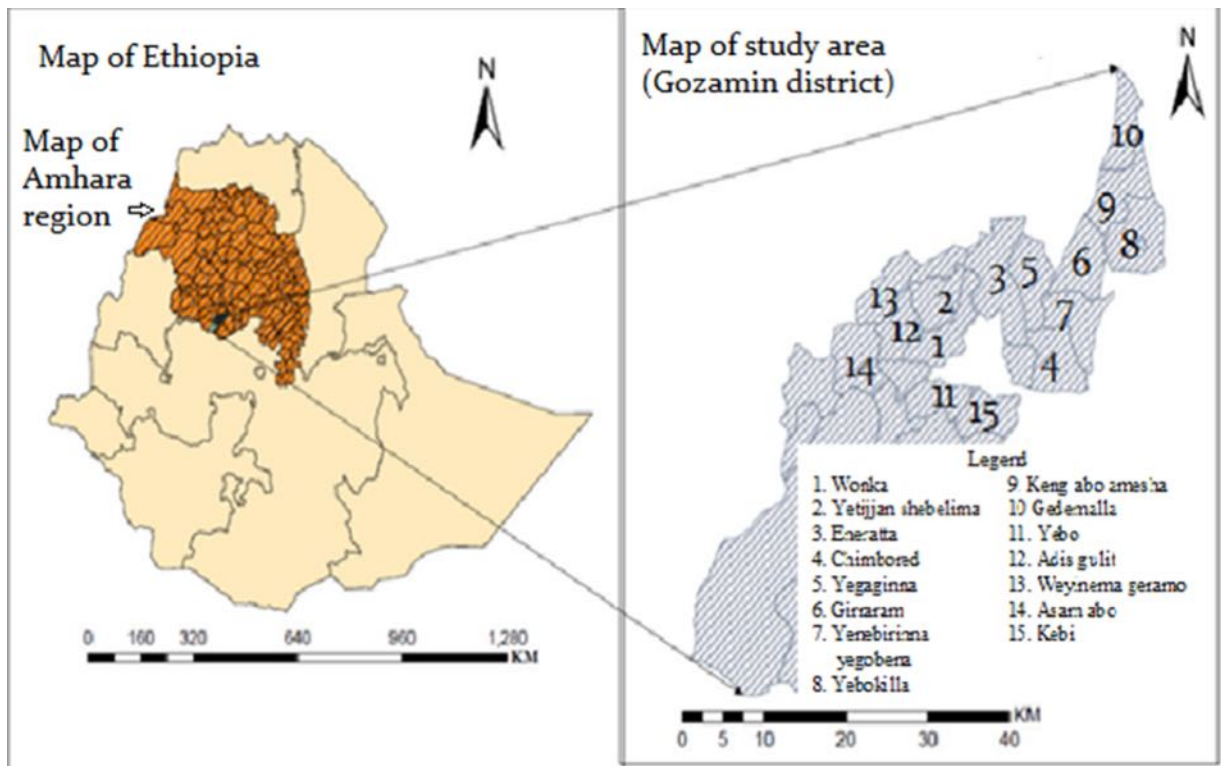


Figure 1: Map of the study area

Study design and sampling technique

A cross-sectional survey design was used in the current study. Data were collected between April and July 2019. Out of the 25 *kebeles* (the smallest administrative unit in Ethiopia) in Gozamin district, 15 were producing oat and intentionally included in the study. All populations in 15 *kebeles* growing the crop were considered as study populations, and the representative sample size was determined according to Yamane formula as indicated in Eq. 1

$$n = \frac{N}{(1 + N e^2)} \dots\dots\dots (1)$$

where: n = Sample size of households in the study area, e = Margin of error (MoE) = 0.05 and N = the total household heads (13049) in 15 *kebeles* producing and consuming oat.

Accordingly, a total of 388 households participated in the survey, and a proportional allocation formula was employed to determine the number of respondents from each sampled *kebeles*. A random sampling method was applied to select respondents involved in the survey study.

Data collection

Both primary and secondary data were collected from different sources. Field observation was conducted to assess the importance of the crop in the food system. In the study area, food preparation was mainly accomplished by women. Thus, a focus group discussion (six FGDs each containing eight women) was held to acquire the traditional oat food recipes and processing cultures in the community. Agricultural experts were intentionally selected to participate in the key informant interviews (12 KII in three groups). It was performed based on prepared checklist item questions. Semi-structured questionnaires were also employed to get data about agronomic information, significance, and extent of utilization of the crop in the society from 388 respondents using face-to-face interviews by the help of facilitators at each *kebeles*. Secondary data sources such as documents and reports from East Gojjam zone and Gozamin District Agricultural Offices were also reviewed. The collected data were then cross-checked and summarized.

Data analysis

Data were edited, coded, entered, and analyzed using SPSS for windows version 20.0. Data from the interview were analyzed and presented using descriptive statistics. Data collected through questionnaire were analyzed quantitatively using percentages, figures, and tables. Data collected through key informant interviews, focus group discussions, and field observation were compiled, expressed, and analyzed by cross-checking questionnaires.

Socio-demographic characteristics of households

In the study, a total of 388 households participated in the individual questionnaire interview. Nearly two-thirds (61.6%) of the respondents were in the age group of 30-50 years. Approximately 99% of the study participants were from a rural area. All participants (100%) were Amhara by ethnicity and Coptic Orthodox Christian by religion. Majority (90.5%) of the respondents were married, and two-thirds (66.2%) of the respondents had four to seven family members. With regards to educational background, 94.8% of the respondents were illiterate. The majority (97.4%) of the households were relying on agricultural practices as their income source. As an alternative income-generating activity, all the respondents participated in livestock production (**Table 1**).

Agronomic characteristics of oat

In 2017, the crop accounted for about 1013 hectares of land coverage and 183.6 tonnes of production yields in Gozamin district. There are five districts in East Gojjam, Northwest Ethiopia that adapt and produce oat as a staple food. Gozamin, Debre Markos, Anded, Sinan, and Machakel districts produced 183.6, 337.5, 14.4, 233.2 and 212.9 tonnes of oat respectively in 2017/2018. Oat farming and production was based on traditional knowledge of the local people.

About 97.2% of the producers cultivated oat every year. As per the results of this study, one can understand that medium to high rainfall is the suitable weather condition for oat farming. Concerning harvesting time, the majority (98.2%) of the respondents reported that it took six months to attain maturity after planting. As compared to other



conventional cereal crops, 85% of the study participants said that little farming is enough to grow the crop with no fertilizer application. Moreover, all producers (100%) did not use herbicides during production time because of the crop's capacity to dominate weeds' growth. Because of these and other benefits, the production cost is relatively lower than other cereal crops commonly cultivated in the specific districts and other parts of the country. The crop's average yield in the study area reported 30 tonnes per hectare (**Table 2**), a bit higher than the average yield of wheat (18.6 tones) and maize (22 tonnes) per hectare in the 2017/2018 production season. Due to these merits, oat's contribution to climate-smart agriculture to support food security efforts is essential. Production of the crop, which is restricted in specific districts, needs to be promoted in other parts of the country to support its food security efforts.

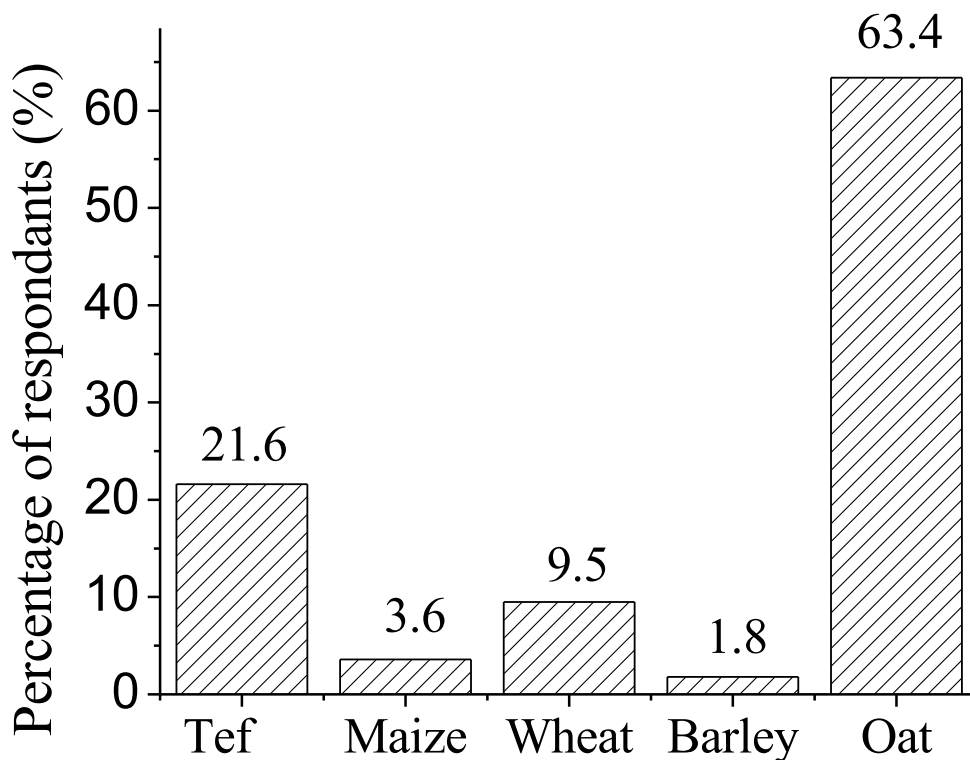
Importance of oat

A high proportion (> 90%) of the study participants consumed oat as a staple food throughout the year. Only 1.6% of the respondents indicated that they consume the crop when there is a shortage of other cereal crops. Most of the study respondents (88.7%) reported that oat as food is most prevalent in rural than urban areas. This urban-rural difference in utilization of oats might be associated with the availability of various food items in the urban community compared to rural areas.

According to literature, oats have high nutritional value due to the high contents of proteins, lipids, soluble fiber, essential amino acids, unsaturated fatty acids, vitamins, minerals, and phytochemical [9, 10]. Oats contain oils to a much greater extent than most other cereal grains [11, 12]. It also contains a balanced composition of amino acids, which has a high nutritional value. Oats are considered a functional food, mainly due to their high content of β -glucan, soluble dietary fiber, and avenathramide, a unique antioxidant of oats [13]. The presence of many health-promoting compounds makes oats an interesting cereal for use in food and bakery products. The current study indicated the potential of oats to be processed into six cultural oat-based foods. Hence, people in the other parts of Ethiopia should exploit the immense production potential of oats in the country's highland and midland areas. It would provide a more diversified food source necessary to address food and nutrition security concerns.

Figure 2 shows that oat is ranked first in terms of consumption at a household level compared to most common cereals such as *tef*, maize, wheat, and barley. Among the respondents, 63.4% preferred oat-based, 21.6% *tef*-based, 9.5% wheat-based, 3.6% maize-based, and 1.8% barley-based foods as their first choice. About 80% of participants consume oat food products daily, and among these respondents, 76.9%, 17.9% and 5.2% consume oat-based food thrice, twice and once a day, respectively. Almost two-thirds (68.6%) of the respondents believed that oat-based food products are popular in the districts because of the desired sensory quality of the grain's foods and availability. Half (49.7%) of the study participants responded that oats' market price is moderate compared to other cereals. As indicated in **Tables 2 and 3**, the study results showed the crop's potential to broaden food availability and diversity at the household level to enhance food and nutrition security.





Cereals consumed at household

Figure 2: Percent consumption of different grains at a household level in Gozamin district

Processing of traditional oat foods

There are three different local landraces of oat grain grown in the district (**Figure 3**). Different types of traditional food were produced from the grain using various conventional processing methods. The community uses oat grain to make different types of foods like *injera* (sourdough risen flatbread with bubbly texture on the top and smooth underside which is a national dish of Ethiopia), *kitta* (single flatbread resembles a pancake), *anebabiro* (Ethiopian flatbread made from the leavened powder of cereals where two flat pieces of bread are overlapped one over the other), gruel, porridge, *enket* (crushed toasted oat grain which is used as the main ingredient for sauces from *sama*, *Utrica simensis* Steudel), and *tella* (local alcoholic beverage).

Traditional foods are foods that were commonly consumed in ancient times by native people all over the world. Traditional foods constitute an essential aspect of a country's cultural heritage, history, lifestyle, and local economy. These foods are accepted and highly consumed by the local people for a long time, and the methods of preparation of such meals have been transmitted from generation to generation [14]. Traditional foods play an essential role in local identity, consumer behavior, the transfer of cultural heritage for future generations, and the interaction of this heritage with the rest of the world [15]. Increasingly, it is being recognized that traditional food systems are

intertwined with the cultural identity of indigenous peoples. Their knowledge of local ecosystems and food sources has evolved over generations [14].

Food preparation is predominantly a household phenomenon in Ethiopia. Every household appears to process food, starting from raw ingredients to the final product [16]. However, there hardly exists any recorded past recipes; instead, the intricate culinary art was handed down like a family heirloom from mothers to daughters. Their culinary art has, for centuries, been regarded as the quintessence of their cultural heritage [17].

Traditional foods can be prepared from any of the various cereals depending on availability and abundance of the grains cultivated in the agro-ecological zones suitable for their growth.



Figure 3: Three different types of raw and dehulled oat grain grown in Gozamin district; a) Oat (white) b) Oat (black) c) Oat (yellow)

Oat injera

Injera is a thin fermented sourdough-risen flatbread with a slightly spongy texture made from flour, water, and *ersho* (mixed culture from spontaneous fermentation, lactic acid bacteria (LAB) and yeast, *Enterobacteriaceae* and *Bacillus* spp., after back

slopping) [18, 19]. More than 70% of the Ethiopian population relies on *injera* for their diet [20, 21].

However, *injera* from oat grain is not accustomed in other parts of Ethiopia except specific study districts. The usual *injera* preparation method varies from household to household that may arise from mixing the flour with water and back slopped culture. The necessary ingredients are oat flour, *ersho* and water. Most of the time maize flour (1/3 portion) is added to oat flour if relatively white *injera* is needed. Moderately fine-milled flour of oat is sieved, and the dough is prepared. The flour is mixed with water and kneaded exhaustively through the addition of water step by step to produce a thick paste. The paste is left at room temperature for 72-96 hours to undergo spontaneous fermentation. After 72-96 hours of fermentation, a portion of the dough was taken, mixed 1:3 (v/v) with boiling water, and heated for 15 min with continuous stirring to make hot cooked *absit* (less thick viscous cooked dough from first fermentation). Part of fermented dough and cooled *absit* to room temperature are then mixed and liquified with hot water to make a batter of desired viscosity and consistency. The less viscous batter is then left for 30 minutes for the second phase of fermentation before baking for the desired quality and oat-based *injera* characteristics.

The dough will then be poured onto the hot flat clay griddle rubbed with rapeseed powder as an oil source for greasing to make circular-shaped *injera* after 2-3 minutes of baking. The *injera's* bottom surface, which touches the clay griddle, has a smooth texture, while the top is porous. Traditional and typical *injera* is round, soft, spongy, and resilient, about 6 mm thick with uniformly spaced honeycomb-like eyes on the top. *Injera* with evenly distributed surface gas holes, soft plumpness, non-sticky, and has slightly sweet taste commonly preferred by the consumers [22].

Oat kitta and anebabiro

Kitta is a dry, thin, flat pita-like bread with a chewy consistency. *Kitta* is commonly prepared as a quick meal for children and family members when *injera* is not readily available. Instant oat *kitta* is prepared from oat flour and water with the addition of a little salt. Alternatively, a one-third portion of the powder might be maize. *Kitta* is a relatively thicker and harder bread but smaller in size (about the size and thickness of a pizza base) compared with *injera*. It can be served either alone or with butter, milk, and linseed paste. The flour and water are mixed well in a bowl by gradually adding water, kneading it well until the dough is smooth and elastic. The dough is slowly poured into the hot pot and flattened to give a thin layer. The lighter the sheet, the better the quality of *kitta*. Then, the pan-baked bread (*kitta*) is removed from the heat and usually served by scrubbing the surface with a mixture of *nitir qibe* (traditional ghee which is prepared by heating Ethiopian butter to its boiling point with selected types of spices) and *awaze* (conventionally fermented condiment and is consumed with other items based on its desirable aroma and flavor. It is the product of the microbial fermentation of vegetable-spice mixtures).

Oat *anebabiro* is a flatbread made from the leavened oat powder where two flat loaves of bread are overlapped one over the other. Freshly made spiced crushed sesame and the *awaze* mixture is rubbed on it before super-imposing the two thin flat slices of



bread. It is served as a snack or breakfast, and its taste liked by the local community. The difference between *kitta* and *anebabiro* is that fresh *kitta* usually prepared as fast food. It does not involve fermentation. Hence the surface of the instant *kitta* does not have gas holes. *Anebabiro* is prepared from two flatbreads which are made from naturally fermented (12 hours) dough. Unlike instant *kitta*, the flat slices of bread for *anebabiro* have holes and spongy appearance.

Oat gruel

Gruel (*Atmit*) is a cereal-flour based viscous drink prepared by cooking oat flour with water, sugar, salt and 'ghee (Ethiopian clarified spiced butter) until the ingredients have combined to create consistency. Oat gruel is a popular cultural drink in Gozamin societies. This food is more favored by people living in towns than in rural areas. According to the study result, gruel involves mixing oat flour (from slightly roasted grain) with other cereal flours (maize or barely) in one-to-one ratio. Gruel is commonly prepared to feed lactating women after birth and for individuals who have less appetite for other solid foods.

Oat enket

Oat *enket* is one of the peculiar traditional foods consumed within populations of the area. It is prepared from crushed oat, *sama* leaves (*Utrica simensis* Steudel), and water. *Sama* is an endemic plant to Ethiopia. Presently, cracking and milling processes of the dehulled oat grain are performed using a motorized mill, but a traditional stone grinder has been used for breaking since ancient times. The twig part of *sama* leaves is collected from the field, and is laid on a cultural tray made from rattan, and the leaves are massaged using a traditional sieve (*wenffit*) to remove the prickle. The smooth *sama* leaves are then boiled with water in a pot made from clay. After removing from the heat, the leaves are squeezed, and the filtrate portion is then taken for further steps. The filtrate is mixed with crushed oat and cooked by adding little water step by step. Alternatively, if the sprout leaves are soft and fresh enough, the crushed oat can be directly added and cooked. After cooking for 5-10 minutes, salt and spiced butter will be added. The resulting green jelly sauce is removed from the heat and served together with *injera*.

Oat porridge

Porridge is one of the most widely consumed foods in Ethiopia. Like other parts of Ethiopia, porridge is also a traditional food among the people of Gozamin district. The difference is on the choice of ingredients; people in this district use oat in place of other cereal crops. Hence, the porridge is made mostly from toasted flour of oat and other cereal crops (rye, maize, barley, and wheat) in 1:1 ratio. Porridge may be served as a main meal (breakfast) or as a meal on special occasions (after birth or holiday). Most often, this food is given to mothers after childbirth. It is also used as a complementary food to feed children under the age of five years.

Preparation of oat porridge involves dehulling of the husk, slight roasting of the grain to prepare the flour. The flour is then added with some salt in boiled water and cooked with frequent stirring. Porridge is usually consumed with a recipe made of glutinous ingredients like spiced butter mixed with hot pepper or chilli powder, honey, or linseed



paste. Porridge should be served immediately after cooking when it is warm for better quality and consistency.

Oat *tella*

Tella is one of the Ethiopian traditional alcoholic beverages, which is prepared from various ingredients. It is made from different cereals like *tef*, wheat, corn, barley, millet or sorghum [23]. It is, by far, the most commonly consumed alcoholic beverage in Ethiopia [16].

Oat is mostly used to prepare *yetella kitta* (a type of leavened *kitta* baked on a wide metal pan into thin flatbread) among Gozamin area peoples. It is one of the ingredients in *tella* making process and used as a fermentable substrate. Additionally, it is rarely used for making *asharo* (deep roasted cereals) used for *the tella* preparation process.

The fermentable grains for *tella* preparation are usually obtained from *yetella kitta*. Flours of toasted oat and water are mixed thoroughly and baked on a wide metal pan into *yetella kitta*, and it is broken into small pieces. *Yetella kitta*, malt flour (*bikil*), and pounded *gesho* (*Rhamnus prinoides*) are mixed thoroughly with water and left to ferment for 1-2 days. The fermenting mixture is commonly called *tinsis*. The second phase fermentation starts when the *tinsis* is added along with adjuncts like *asharo* to form a thick blend of ingredients known as *difdif*. *Difdif* is kept covered to allow the fermentation for three to seven days which is dependent on the temperature of the environment. The third fermentation phase is initiated by diluting the *difdif* with water. The mixture can take two to twelve hours to end its fermentation. Lastly, most suspended materials settle to the bottom of the container, and the solution is then decanted to obtain a clear dark brown liquid, *tella*. Sometimes, at the end of the third stage, a lesser water volume is mixed with the *difdif* and more alcohol concentrated *tella* is obtained by filtering the *difdif* through a cotton cloth and keeping it in a closed container. Such *tella* is known as filtered *tella*.

The production process of *tella* is similar to beer making in that the grain starch is converted into pure sugar by malting. However, no yeast is added for fermentation in *tella*; it utilizes the natural yeast present in the grains and the environment [24]. The alcohol content of unfiltered *tella* is usually around 2-4%, while filtered *tella* contains about 5-6%. Traditional alcohols are more preferred by the people living in Ethiopia's rural and small towns, and its popularity is on the rise, even in the cities [25]. Drinking locally prepared alcoholic beverages is common during different cultural and religious festivities.

CONCLUSION

Oat is a principal crop with high socio-cultural and economic values among the inhabitants of Gozamin district. It is tolerant to acidic and marginally fertile soils where other plants do not grow and yield well. It requires neither repeated ploughing of land nor utilizes fertilizer and herbicide. Low-income producers can quickly adapt and cultivate oat with less cost of production. The crop is traditionally processed into different staple foods at a household level including *injera*, *kitta*, *anebabiro*, gruel,



porridge, *enket*, and *tella*. Oat is consumed most in Gozamin district at household level compared to most common cereals such as *tef*, maize, wheat, and barley. The community in the specific districts has been consuming the crop perhaps for a century. It is proven that oat is one of the staple foods and can be promoted in other parts of the country as an alternative to other costly cereals. It is also necessary to study the nutritional composition and health benefit of the grain for further use. Conventional processing methods for the production of traditional food types from the grain need to be optimized.



Table 1: Socio-demographic characteristic of respondents from 15 selected *kebeles* of Gozamin district

Variables	Category	Frequency	Percent	
Age (in completed years)	15-30	62	16	
	31-50	239	61.6	
	51-75	87	22.4	
Religion	Coptic Orthodox	388	100	
Ethnicity	Amhara	388	100	
Marital status	Single	8	2.1	
	Married and living together	343	90.5	
	Married but not living together	15	3.9	
	Widowed	15	3.9	
	Divorced	7	1.8	
Educational status of wives	Illiterate/ informal education	368	94.8	
	Formal education	Primary School	12	3.1
		High School	6	1.6
		Above High School	2	0.5
Educational status of husbands	Illiterate/ informal education	360	92.8	
	Formal education	Primary School	18	4.6
		High School	8	2
		Above High School	2	0.5
Occupation of wives	Housewife	5	1.3	
	Farmer	381	98.2	
	Daily laborer	2	0.5	

Occupation of husbands	Farmer	378	97.4
	Merchant	5	1.3
	Daily laborer	5	1.3
Household size (number of people living in the HH)	0-3	37	9.6
	4-7	257	66.2
	8-12	94	24.2
Place of residence of the respondents	Rural	383	98.7
	Urban	5	1.3

Table 2: Agronomic, production and yield characteristics of oat

Variables	Category	Frequency	Percent
Frequency of cultivation	Every year	377	97.2
	Once for every two years	11	2.8
Required time for harvesting	Five months	7	1.8
	Six months	381	98.2
Suitable weather conditions	High rain	86	22.2
	Medium rain	278	71.6
	Low rain	2	0.5
	All are suitable	22	5.7
Farming practices	No farming (no ploughing)	6	1.5
	Little farming (ploughing 1-2 times)	331	85.3
	Medium farming (ploughing 4-5 times)	51	13.1
Fertilizer use	Very little fertilizer (100 kg per hectare)	11	2.8
	No fertilizer is applied	377	97.2
Pesticides application	No	388	100
	Yes	0	0
Productivity per hectare (tonnes)	2.5-2.8	81	20.9
	2.9-3.2	229	59
	3.3-3.6	78	20.1

Table 3: Information on the importance of the crop

Variables	Category	Frequency	Percent
Oat is an edible food source	No	0	0
	Yes	388	100
The cereal consumed most in your house	<i>Tef</i>	84	21.6
	Maize	14	3.6
	Wheat	37	9.5
	Barley	7	1.8
	Oat	246	63.4
Occasions where oat is consumed as a food	All the time (year to year)	382	98.5
	Only summer	3	0.8
	During famine	3	0.8
Oat is used as	Main dish	385	99.2
	Snack	3	0.8
Oat consuming peoples are	Economically less	16	4.1
	Economically moderate	6	1.5
	Both economically less and moderate	17	4.4
	All economic class	349	89.9
Oat foods are most popular in	Urban	3	0.8
	Rural	344	88.7
	Both urban and rural	41	10.6

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