

**ASSESSMENT OF TRADITIONAL BUTTER PRODUCTION,
HANDLING, MARKETING AND ITS PHYSICO-CHEMICAL
PROPERTY IN TULLO AND MESELA WOREDAS OF WEST
HARARGHE ZONE, OROMIA, ETHIOPIA**

MSc THESIS

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SEPTEMBER 2024

HARAMAYA UNIVERSITY, HARAMAYA

**Assessment of Traditional Butter Production, Handling, Marketing and its
Physio-Chemical Property in Tullo and Mesela *Woreda* of West Hararghe
Zone, Oromia, Ethiopia**

**A Thesis Submitted to the School of Animal and Range Science, Post
Graduate Directorate.**

HARAMAYA UNIVERSITY

In Partial Fulfilment of the Requirements for the Degree of

MASTER OF SCIENCE IN AGRICULTURE

(ANIMAL PRODUCTION)

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September 2024

Haramaya University, Haramaya

APPROVAL SHEET

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We here by certify that we have read and evaluated this Thesis entitled “Assessment of Traditional Butter Production, Handling, Marketing and Its Physio-Chemical Property in Tullo and Mesela Woredas, West Hararghe Zone, Oromia National Regional State, Ethiopia” prepared under our guidance by Endashaw Gebeyehu. We recommend that it be submitted as fulfilling the thesis requirement.

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DEDICATION

This work is dedicated to my late father.

STATEMENT OF THE AUTHOR

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BIOGRAPHICAL SKETCH

The author Endashaw Gebeyehu was born in August 1982 in the Doba District of West Hararghe Zone of Oromia Regional State of Ethiopia from his father Gebeyehu Shiferaw and his mother Yismashewa Assefa. He attended his elementary education at Wolkituma Wogi Elementary School and attended his secondary school education at Hirna Secondary School. After successful completion of his secondary school education, he joined Holeta Agricultural ATEVET College in 2005 and graduated with a Diploma in Animal Science in July 2008 with great distinction. After his graduation, he joined Mesela Woreda know Shenen Dhugo Livestock and Fisheries office as a Development Agent and served for 13 years. During this time, he got the chance to work with different governmental and non-governmental organizations serving as a focal person at the kebele level, then taken to the Woreda Livestock and Fisheries Office as an Expert. He got a chance to upgrade his level of education at Haramaya University Chiro Campus in 2010 and graduated with a BSc degree in Animal Science with great distinction in 2015. Then he joined Haramaya University, Post Graduate program, School of Range and Animal Science in February 2020 to pursue his MSc degree in Animal Production.

ACKNOWLEDGEMENTS

I have no words to express the kindness and faithfulness of the Almighty God in bestowing and providing me health, strength, patience, and protection towards the completion of this study. I would like to extend my sincere and deepest thanks to my major advisor Dr. Takele Wolkaro. Every effort to come up with this full-end thesis was meaningless without great support, guidance, helpful comments, encouragement, follow-up, friendly approach, innumerable revisions and reorganizations at all stages of the work and the prompt response made to improve my work. My unreserved thank also goes to my co-advisor Dr. Tibebu Manaye for his constructive comments, intimate follow-up, patience, and unconditional devotion to his time.

My special gratefulness goes to my mother Yismashewa Assefa, my late father Gebeyehu Shiferaw, my wife Simegn Taddesse, the two of my God gift (sons) Kaleab Endashaw (Tokicho) and Alazar Endasshaw whose are the base for all my achievements in my finding. They reached the milestone and made untold sacrifices for today's success. I would like to express my heartfelt thanks to all of you, I am also highly indebted to my all brothers and sisters for their guidance, support, intimate follow, and encouragement.

I am grateful to Haramaya University Dairy Laboratory for allowing me and help technically to get Laboratory results for my study, especially Fuad and Kedede am give a great thanks for your participation. Besides, I owe special thanks to Shenen Dhugo Agricultural and Natural Resource office, and 140 of my respondent farmers lost their time and allowed me to get true information, last, but not least, I am very much thankful to all of you.

ABBREVIATION AND ACRONYMS

AOAC	Association of Official Analytical Chemists
CSA	Central Statistical Agency
DA	Development Agent
ESA	Ethiopian Standard Authority
FAO	Food and Agricultural Organization
GC	Gregorian calendar
GDP	Gross Domestic Product
He.	Hectare
HH	House hold
ILCA	International Livestock Center for Africa
ILRI	International Livestock Research Institute
MASL	Meter above Sea Level
MOARD	Minter of Agriculture and Rural Development
SPPS	Statistical Package for Social Science
TWAO	Tullo Woreda Agricultural Office
USDA	United State Development Agent
WHO	World Health Organization

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ABSTRACT

Across-sectional survey was employed to assess butter traditional production, handling and marketing practices in Tullo and Mesela Woredas of West Hararghe Zone, Oromia, Ethiopia. Semi-structured questionnaire and focus group discussion were the methods utilized for data collection. The questionnaire were pre-tested and administered to 140 respondents, with 77 from Tullo and 63 from Mesela Woreda. Additionally, a total of 30 samples each weighs 50 gm butter from each producer for physicochemical analysis were obtained from 30 producers that participating in the survey. The data for physio-chemical property analysis was collected from Haramaya University Dairy Technology Laboratory. Statistical Package for SPSS was used to analyses the data. Results show that, women and daughters were entirely responsible for butter production and handling in the study areas. In Mesela Woreda, 47.6% of the respondents were used bottle guard churners and 52.4% used plastic churners for butter making. In Tulo Woreda, 49.6% used bottle guard while 50.4% used plastic churner for butter making. About 60.3% and 64.9% of the respondents in Mesela and Tulo Woreda, respectively utilized butter for cosmetics purpose. About 39.7% and 45.4% of the respondent in Mesela and Tulo Woredas, respectively used Sheketi (traditionally prepared equipment) to handle butter. As the result indicated 100%, female has responsibility to sell butter in the study districts. 61.9% and 72.7% in Mesela and Tulo Woreda, respectively, butter buyer conceder freshness as quality factor. In the study districts the overall mean value of moisture content of butter was 18.43 ± 0.37 and 18.67 ± 0.53 which is higher than the value of standard butter (16%). The fat content of butter collected from Mesela and Tulo Woreda were 77.91 ± 0.50 and 78.64 ± 0.50 , respectively that indicates lower than the value of standard (80%). To concluded that from the results for physicochemical property indicates the butter produced in study districts has lower quality. It is recommended that efforts should be made to improve awareness among butter producers, especially on modern dairy handling and processing practices. This could help improve product quality and safety. Regular training on butter production is important to ensure butter meets both local and international standards.

Keywords: *butter, production, handling, physicochemical property.*

1. INTRODUCTION

Ethiopia is home to a huge number of livestock due to its diverse and broad agro-ecology, as well as due to the importance of livestock in subsistence livelihood. Ethiopia boasts the largest livestock stockpile with 70,291,776 cattle, 42,914,865 sheep, 52,463,535 goats, 2,148,492 horses, 10,791,896 donkeys, 382,784 mules, 8,145,790 camels, 56,992,987 poultry, and 6,986,100 bee hives (CSA, 2021). Female cattle make up around 56 percent of the entire cattle population that provide 83 percent of the milk produced in Ethiopia, while goats and camels provide the remaining 3% (MoARD, 2007). According to the CSA (2021), total cow milk output in rural sedentary areas of the country reach around 4.96 billion liters, with an average lactation time of about seven months and an average milk yield per cow per day of around 1.482 liters.

The majority of African and Arabian countries have traditionally manufactured and consumed indigenous dairy products generated from cow and goat (Mourad and Nour-Eddine, 2006; Mattiello *et al.*, 2018). In Africa, milk can be purchased fresh; consumed fermented; or processed into butter, ghee, or cheese. In Ethiopia, smallholder farmers and pastoralists together produce and supply 98% of the total annual milk production (CARE-Ethiopia, 2009). The vast majority of milk produced outside urban centers in the country is processed into milk products at household level using traditional technologies (Tegegne *et al.*, 2013). In the rural areas of Ethiopia, it is estimated that 40% of the milk produced is converted to butter, while only 9% is converted to cheese. Traditional butter ferments slowly at room temperature, offering rural consumers a readily storable and durable dairy product (Shapiro *et al.*, 2015).

Producers in remote locations are motivated to produce butter for a variety of reasons some of which are restricted market outlet; shorter shelf life; as well as convenience of handling and product diversification for consumption (Alganesh, 2002; Ayantu, 2006 and Kassahun, 2008). Dairy processing in Ethiopia is generally based on ergo (fermented milk), without any defined starter culture, but with a natural starter culture (Mogessie, 2002) that will be churned into traditional fat called “*kibe* (Debela, 2016). Butter (*Kibe*) has an attractive appearance with a white to yellowish color manufactured traditionally from sour milk (ergo). Like factory-processed butter, it is semi-solid at room temperature.

Butter is a classic natural food that is consumed all over the world and is necessary for human nutrition. It is a vital source of energy and contains many other nutritionally important components, such as minerals and vitamins, thanks to its high fat content (Dvorák *et al.*, 2016).

According to a review done on the Ethiopian dairy sector by Zelalem *et al.* (2011) out of the national total butter produced, 80% is used as a food ingredient, and the rest is used as cosmetics for hairdressing. Out of the 80% used for food, 70% is used in rural and nearby urban areas, while 30% is channeled into the market. The review concluded that the processing of milk into butter, in addition to its nutritional and economic importance for rural people, saves the milk from spoilage and diversifies its use.

The production, processing, handling, traditional preservatives, and preservation techniques of butter require great care to maintain its quality. In different rural areas of Ethiopia, producers use different traditional preservatives and preservation methods to increase the shelf life of butter (Alganesh and Yetenayet *et al.*, 2017; Abebe *et al.*, 2013). These traditional preservatives are used as a principle of acidification and moisture reduction making butter to have good storage stability (Mahony and Peters, 1987).

The quality of butter is closely related to its physicochemical and microbiological characteristics. Besides fats, butter contains small percentages of proteins, milk sugar, and water, which make it a suitable substrate for microorganisms (Mahendra *et al.*, 2016; Singh *et al.*, 2011). The butter quality standard specifies butter to have a maximum of 0.4% free fatty acids, 80% fat, and a maximum of 16% water (FAO and WHO, 2011). According to the USDA standard (USDA, 2018), the ash content of butter must be 0.09 percent.

Livestock and livestock products like milk, butter, and meat are some of the income generators for the farmers living in areas of West Hararghe Zone. Among those areas, Tullo and Mesela Woredas are well known for common livestock and livestock products. Particularly butter from those Woredas is a prominent (likely to attract attention) and preferable commodity in the market. Even if the areas have good potential in butter production, there is not enough scientific information on the quality of butter made from cow milk. On the other hand, most of the villages in those two Woredas are far from main roads and the milk producers are settled scattering limiting access to the milk market individually and as cooperatives leading to wastage. Producers engaged to produce butter instead of selling milk. Therefore, assessment of traditional butter

production, handling, marketing, and analysis of its physicochemical properties is important in the application of cost-effective strategies of production, to supply an adequate amount and quality of butter which is safe to eat. Hence, this study was initiated with the following objectives.

General objective

- To assess traditional butter production, handling, marketing, and its physicochemical properties in *Tullo* and *Mesela Woredas*.

Specific objectives

- To assess traditional butter production, handling, and marketing in *Tullo* and *Mesela Woredas*.
- To evaluate the physicochemical properties of butter produced in *Tullo* and *Mesela Woredas*.

2. LITERATURE REVIEW

2.1. Traditional Milk Production in Ethiopia

Milk is a complex biological fluid and it is the largest source of animal-based protein used for improving nutritional and health outcomes in developing countries, predominantly for children. It plays a vital role in every person's life, for getting good health and giving energy. We can get more minerals, vitamins, and calcium from milk (Ezhil *et al.*, 2018). In Ethiopia, milk production has increased considerably since 2000. The Central Statistics Agency estimated that national milk production was 1.2 billion liters in 2000, 3.2 billion liters in 2007, and 3.3 billion liters in 2012 (Shapiro *et al.*, 2015).

Milk production in Ethiopia is mainly dependent on indigenous breeds, more specifically on cattle, goats, and camels. Cattle have the largest contribution (81.2%) of the total national annual milk output, followed by goats (7.9%), camels (6.3%) and sheep (4.6%) (CSA, 2014). The estimate of total cow milk production for the rural sedentary areas of Ethiopia is about 3.06 billion liters (CSA, 2017).

Even though Ethiopia's production of milk increased from time to time, the per capita milk consumption is much lower (19 kg/year) than other African countries (27 kg/year), Zelalem (2017). In a USAID report (USAID, 2013), it is indicated that in Ethiopia, 68% of the total milk produced is used for human consumption in the form of fresh milk, butter, cheese, and yogurt, while the remaining is given to calves and wasted in the process. Butter is the most widely consumed milk product in the country. Of the total milk produced, 40% is converted to butter, while only 9% is reserved for cheese (Mebrate, 2019).

According to Hailemikael (2019), consumption patterns of milk and milk products depend on the amount of milk produced per household, the geographical setting of the area, the dairy production system and market access, seasonality, and fasting periods (particularly for the followers of orthodox Christians).

2.2. Traditional Butter Production in Ethiopia

Butter is defined as the semi-solid white/ yellow emulsion of fat, air and water made exclusively by churning of milk or cream or both with/without addition of coloring materials and salt; contains not less than 80% by weight of milk fat (Robert and Marianne, 2009). It can also be categorized as cultured or sour cream butter made from bacteriologically soured cream. But, in Ethiopia, butter is made from spontaneously fermented milk (O'Connor, 1995; Gebremedhin et al., 2014; Debela *et al.*, 2016) from cow milk for preparing different traditional diets and for hairdressing purposes.

2.2.1. Milk collection

Milk for churning is accumulated for three to four days by adding fresh milk to milk stored in a clay pot or gourd and is left for spontaneous fermentation (O'Connor, 1995; Debela *et al.*, 2016). Milk is accumulated over several days by adding fresh milk to the milk already accumulated in traditional spherical earthenware vessels or *wesso* or bottle gourds and allowed to sour into yogurt or naturally fermented milk (Debela, 2016).

2.2.2. Cleaning and Fumigation of Milk Utensils

A report by Alganesh and Fekadu (2012) revealed that stems and leaves of *Ocimumhardiense* are used for cleaning milk vessels and churns in East Wollega. To make butter, a clay pot or bottle gourd (calabash) is used as a churner (Abebe *et al.*, 2013). Churners are smoked with chips of *Olea Africana* in the Asela areas (Taye, 1998). Gaarrii, *Syzygiumguineense*, and *Olea Africana* are used by some smallholders (Alganesh and Fekadu, 2012). In southern Ethiopia, Mekdes (2008) reported *Gucha*, *Achynthesaspera*, and *Eucalyptus globules* as the most important plants used for smoking churns and milk containers. Another report by Fikirneh *et al.* (2012) in the mid-rift valley revealed *Juniperousprocera*, *Eruchstrumarabicum*, and *Sidacuneifolia* being used for smoking milk vessels, in addition to other trees. According to the local understanding, the practice of smoking vessels by burning wooden chips of specific trees and shrubs has the advantage of imparting a special flavor and odor to the product, and disinfecting the vessels. The report of Ashenafi (2006) indicates greater numbers and faster

development of aerobic mesospheric microorganisms occurred in milk kept in non-smoked containers as compared to smoked containers.

2.2.3. Butter Making

After smoking the churn, the curd is broken either by hand or by agitation with a wooden stick, and the fermented milk is filled to about half of the capacity of the churner, or filled to a level depending on the availability of fermented milk. After filling, the churner is tightly closed with a plug, a piece of skin or leather (specifically made for this purpose only). After the mouth of the churn is securely tied, agitation is performed for 3–4 h, depending on environmental temperature, fat content, level of acidity of fermented milk, and the speed at which the churning is done. Churning is exclusively done by women or children (Coppock, 1994; Alganesh and Fekadu, 2012). Fermented milk is thoroughly mixed with a wooden stick and churned in a gourd/clay pot at about 70% of its holding capacity (O'Connor, 1995). Local churners are made from clay, gourds, and wood, and can be woven from fiber, such as the *gorfu* container used by the Borana pastoralists in Ethiopia (O'Connor, 1994). Butter grains are formed and float in the water-based portion called buttermilk. The buttermilk is then drained; grains are then pressed and kneaded together (Gebremedhin *et al.*, 2014) to make the final butter.

2.3. Types of Butter produced in Ethiopia

In Ethiopia, there are two types of butter: ripened/rancid and fresh, in Amharic, called *besal kibe* and *legakibe*, respectively (Mekedes, 2008). However, Abebe *et al.*, (2014) reported that there are three types of butter in Ethiopia, namely *lega*, *mekakelegna*, and *basil*, which refer to fresh, semi-rancid, and rancid butter, respectively, based on the degree of lipolysis of butter. Butter is semi-solid at room temperature. It has a pleasant odor when fresh, but with an increase in storage time, changes will occur in odor and taste, unless refrigerated or further processed into traditional ghee by boiling with spices (Lola and Haile, 2015). Traditional ghee is the most stable product of all traditionally ferment milk products. It has a relatively good keeping quality of 4–6 weeks at ambient temperature as compared to other dairy products such as cottage cheese (Layne, 1994). The storage stability of butter gives it a distinct advantage over fresh milk in terms of more temporal flexibility for household use and marketing (Layne, 1994).

2.4. The Use of Traditionally Produced Butter

Butter and some dairy products are called "yellow fats," which include several products for spreading on bread or for indirect consumption as ingredients in other foods (Embaye, 2010). Fresh/raw butter is used for hairdressing for women as hair cosmetics and as a skin cosmetic for both sexes. A review of the Ethiopian dairy sector (Zelalem *et al.*, 2011) revealed that the use of butter as hair oil is assumed to have dual functions: for hairdressing and to cure headaches.

Butter is also used as an ointment and for relief from wounds (Pojsalk, 2020). Fresh butter is also used by children of weaning age and the elderly. In a study conducted in the Borena region of Ethiopia, butter was found to be an important source of energy as food for humans and is used for cooking. According to Zelalem *et al.* (2011), in different regions of Ethiopia, 60.77% is utilized for home consumption, the remaining 36.36% is sold and used for household expenditure, 0.23% is paid as a wage in kind for casual labor, and 2.64% is for hairdressing and ointment.

2.5. Butter Packaging Materials and Butter Handling

According to the Ethiopian Standard Authority (ES) (2009), butter should be packed in containers that are proof of water and fat, non-absorbent, and non-harmful to its composition, flavor, and appearance. In the case of smallholder farmers making butter, contamination can occur from packing material, an unclean surface, the butter maker, wash water, cups, and leaves (Alganesh *et al.*, 2017). Moreover, traditional equipment is often porous and harbors dirt and microorganisms (O'Mahoney, 1988). Fellows (2008) recommended that butter and ghee can have a longer shelf life if they are stored in a cool place, using airtight, light-proof, and moisture-proof containers to slow down the development of rancidity. Simon (2012) also stressed that the quality of ghee can be affected by many factors, such as the type of packaging material, permeability to oxygen and moisture, method of manufacture, presence of antioxidants, light, and others.

Leaf of false banana (*koba/inset*) is the most common material used for butter packaging in the southern parts of Ethiopia. *Koba* is believed to be important for keeping butter fresh until marketed. According to Mekdes (2008), however, some respondents indicated that the leaves may reduce the weight of the butter because when the cover is removed, some butter remains stacked on the leaves. The same author recommended further study on the effect of packaging

butter with leaves on its quality and sensory characteristics. In other parts of Ethiopia, the use of clay pots for storage or packaging of various dairy products, including butter and ghee, is common (Eyassu and Asaminew, 2014).

2.6. The Butter Marketing System in Ethiopia

Smallholder dairying has the potential to provide significant benefits to the rural population in terms of income (Kidoido and Korir, 2015), nutrients (FAO, 2013), and job opportunities (Kaitibie *et al.*, 2010). The sector also provides opportunities to improve the livelihood options of women (Quisumbing 2013; Johnson *et al.* 2015), since in most developing countries, milking, processing, and marketing of milk and milk products are the responsibility of women (Quisumbing 2013; Johnson *et al.* 2015).

Smallholder farmers in the highlands produce fresh milk and processed products such as butter and local cheese (*ayib*). In rural areas, fresh milk is used for household consumption, and processed into butter, and sold in nearby or faraway markets. Zegeye (2003) also asserted that butter dominates dairy marketing and that the transaction in the form of raw milk is limited to the surroundings of major urban centers

The most important selling attribute of butter is its flavor, which is the main reason for its higher selling price than that of other fats. The flavor of good quality butter is very delicate, and even small amounts of bacterial growth can change its pleasant flavor and aroma. In most cases, butter consumers or traders consider its sensory characteristics while buying from producers (Abebe *et. al*, 2020). This same author also reported that butter that fails to meet these sensory characteristics is sold at a lower price, which affects the income of producers. Similarly, the production of safe and wholesome products would improve the product's marketability and demand (Abebe *et. al*, 2020)

The traditional butter market is part of the informal market. Farmers, mostly women, take the products weekly or monthly to market places or sell them at farm gates to traders/brokers who then accumulate them and pass them on in bulk to licensed butter traders who transport them to more distant markets, mostly Addis Ababa by truck. Traders also purchase butter with a better shelf life from farmers at farm gates or at market places for resale in urban and rural markets at relatively high prices. The retail price of butter fluctuates depending on its quality and market demand, which is high during feasts but low during fasting periods (Abebe, *et al.*, 2020).

2.7. Physicochemical Properties of Traditionally Produced Butter

According to Zelalem (1999), traditionally made butter produced in the central highlands, contains approximately 81.7% fat, 1.1% protein, and 0.23% ash. However, a study conducted by Mekdes (2008) in Southern Ethiopia found that *kibe* contains 20 to 43% moisture, 84.82–86.86% total solids, 80.53–82.53% fat, and 0.12–0.02% ash. The quantities of the main constituents of dairy products, including butter, can vary considerably depending on the animal breed, stage of lactation, age, and health status of the animal (Ewunetu, 2018). Herd management practices and environmental conditions also influence dairy product composition. Besides, the moisture content of local butter can vary depending on the extent of kneading or working of butter (Connor, 1994). On the other hand, in the case of butter that is made using modern technology, the main constituents are standardized (Abid *et al.*, 2017).

Milk fat contains many components that are beneficial for human health, such as lipid-soluble vitamins, antioxidants, unsaturated fatty acids (Mnsson, 2008; ErKayengül, 2015), and about 400 different fatty acids (Mnsson, 2008). Butter contains a large amount of milk fat (at least 80%) and a lesser proportion of other milk components (Demirkol *et al.*, 2016; Méndez-Cid *et al.*, 2017).

The quality of butter is closely related to its physicochemical and microbiological characteristics. Besides fats, butter contains small percentages of proteins, milk sugar, and water, which make it a suitable substrate for microorganisms (Mahendra *et al.*, 2016). Although butter spoilage is most often due to the development of chemical rancidity, microbiological problems also occur in the form of cheesy, rotten, or fruity odors and the rancid flavor produced by hydrolysis (Rady and Badr, 2003). The standard specifies butter to have 0.4% maximum free fatty acids, 80% fat, and a maximum of 16% water, FAO and WHO (2011).

The microflora of butter reflects the quality of cream, the sanitary conditions of equipment used in the manufacture of butter and the environmental and sanitary conditions during packaging and handling, so it is advisable to adopt strict hygienic measures. Krause, Lopetcharat, and Drake (2007) influence the texture and flavor of butter. Every butter has its own specific properties depending on the province it was produced in (Engül, *et al.*, 1998).

One of the major problems regarding butter is rancidification, which is caused by the long-term storage of butter (Abid *et al.*, 2017; Méndez-Cid *et al.*, 2017). In addition, lipolysis leads to serious problems such as decreased nutritional quality and off-flavors (butyric, rancid, bitter, unclean or soapy) in milk and dairy products (Méndez-Cid *et al.*, 2017).). Oxidation is another significant problem regarding fatty products that contain large amounts of unsaturated fatty acids (Méndez-Cid, *et al.*, 2017).

3. MATERIALS AND METHODS

3.1. Description of the Study Areas

This study was conducted in the two purposively selected *Woredas* (*Tullo* and *Mesela Woreda*), of West Hararghe Zone of Oromia Region, Ethiopia selected based on butter production potential. *Tullo Woreda* has an estimated total population of 209663 and 41933 households. Of this population, 11% are urban dwellers and 89% are rural dwellers and has a total livestock population of 131763 cattle, 89528 goats, 34504 sheep, 6679 donkeys, 264441 chickens, and 8259 bee colonies (TWAO, 2020). The *Woreda* is divided into 30 rural kebeles and 3 kebeles in the town. Out of the *Woreda*'s total area, 18438 ha is agricultural lands, 22289 ha is forest and shrub lands, 253 ha is grazing lands, and 5838 ha is settlement lands which is characterized by three agro-ecological zones: highland (*Dega*) 40%, medium-high land (*Weynadega*) 50%, and low land (*kola*) 10%. Further, it is mostly characterized by flat and undulating land features with altitudes ranging from 1600 - 2797 m.a.s.l, and dominated by black and loam soil types, respectively. The daily mean temperature of the *Woreda* ranges from 18°C to 26°C with an average of 22°C and mean annual rainfall ranges from 550mm to 800 mm (TWAO, 2020).

Mesela Woreda has estimated area of 68,657km² with 25 rural Kebele and one administrative town (Auar, 2017). According to the MWAO (2021) report, the *Woreda* has 121,596 cattle, 50,321 sheep, 74,424 goats, 11,456 equines, 267,026 chickens, and 13,791 honey bee colonies population. According to an inference made from population and housing census data in the year 2010, the total population of the *Woreda* was 188,578 (95,430 male, 93,148 females) (CSA, 2007). The altitude ranges from 1200 to 2900 meters above sea level, while the mean annual rainfall of the *Woreda* varies from 700 mm to 1000 mm, and the average rainy days are 180 days in a year. The rainfall pattern is bi-modal, which means a short rainy season in the *Belg* season from March to April and a long rainy season in the *Meher* season from June to September. (MWARDO, 2015). The annual temperature ranges from 10 °C to 15 °C, with a wet season (June to September) and a dry season (October to March) ranging from 24 °C to 28 °C (MWARDO, 2015).

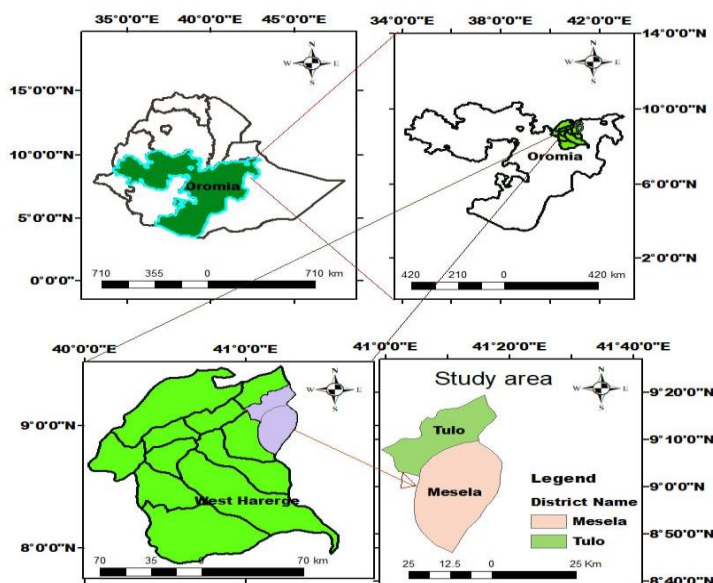


Figure 1. Map of study area

3.2. Sampling and data collection

3.2.1. Sampling methods

The study population includes some smallholder farmers who participate in traditional butter production from local cows, found in selected kebeles of Tullo and Mesela *Woreda* that chosen purposively. Three Kebeles from each *woreda* were selected purposively depending on their potential for butter production. Accordingly *Beeches, Gara Kufa* and *Oda Belina kebeles* from *Tullo woreda* and *Baha Biftu, Lubu Dekeb,* and *Hakan Jirata kebeles* from *Mesela Woreda* were selected for the study.

A two-stage sampling procedure was applied to select sample butter-producer households in the study area. In the first stage, six potential butter producer Kebeles (*three from each Woreda*) were purposively selected based on their potential for butter production. In the second stage, a total sample of smallholder butter producers were selected from those 6 rural Kebeles by using a simple random method from total population. The total number of smallholder farmers that participate in butter production in the six selected *Kebeles* of the two *Woreda* was 1346. From

those total populations, the sample size of butter producers was calculated using Yamane (1967) formula given as:

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

Where:

n = sample size, N = population size, and e = level of precision.

Depending on the above Yamane formula, the sample size was selected as follows with a 92% confidence interval and 8% level of precision from N = 1,346

$$n = \frac{N}{1 + N(e)^2} = \frac{1346}{1 + 1346(0.08)^2} = 140$$

Where: N = population size = 1346, and e = level of precision = 8%.

Therefore, the total sample size selected from six kebeles was 140. But these six kebeles do not have an equal number of butter producers. To balance the number of samples selected with the proportional respective number of butter producers in each *Kebeles*, proportional sampling was used which is given as:

$$n_h = \frac{n * N_h}{N}$$

Where:

n_h Represents a sample size of butter producers chosen from each *Kebele*

N_h The number of total butter producers in each *Kebele*

n is the total sample size or the number of butter producers selected from all kebeles

N is the total number of butter producers in all selected kebeles.

Therefore, the sample size of butter producers selected from each *Kebeles* was given in the following table.

Table 1: Samples selected from each kebeles

Number	Kebele name	Total number of butter producers in Kebele (N_h)	Sample size selected from each Kebele (n_h)
1	<i>Bechesa (Tullo)</i>	259	27
2	<i>Oda Balina (Tullo)</i>	229	24
3	<i>Gara Qufa (Tullo)</i>	252	26
4	<i>Haqan Jirata (Mesela)</i>	248	26
5	<i>Lubu Daqab (Mesela)</i>	164	17
6	<i>Baha Biftu (Mesela)</i>	194	20
	Total	1346	140

A total of 140 respondents were interviewed using semi-structured questionnaire. The survey was focused on household characteristics, traditional butter production systems, butter handling, butter marketing, and subsequent handling of butter (during processing, storage, and marketing).

3.2.2. Methods of data collection

The survey employed Semi-structured questionnaire administration and focus group discussion to collect data on household characteristics, butter production systems, handling, and marketing. The focus group discussion was held with DA, Woreda experts and butter producers to obtain the data on perception of the traditional butter production, handling, and marketing. A total of 8 focus groups were formed; one in each Woreda (a total of 2 groups those are experts) and one in each 6 Kebele (a total of 6 groups those are female producers) that have 8 – 10 members in each group. The butter samples were obtained from butter producers who participated in a survey (respondents) to determine butter's physicochemical properties, and its data was collected from Laboratory findings.

3.2.2.1. Butter sampling

A total of 30 butter samples (5 from each Kebeles and weighs 50 gm from each producer) were obtained randomly from 140 smallholder farmers (female) that participated in the survey. Traditionally prepared cow's milk butter samples were brought from producers for analysis of the physicochemical properties of butter. The butter samples were kept in a labeled sterile plastic bottle, securely capped, and immediately put into an ice box of 4 °C temperature. The samples

were transported to Haramaya University Dairy Technology Laboratory for analysis without delay.

3.2.2.2. Butter physiochemical property analysis

A drying oven was used to dry butter samples for determination of moisture content, solid nonfat (SNF), and fat content of the butter samples by following the procedure used by Evers *et al.* (2003). Five grams of butter sample was measured and put into an aluminum sheet separately for each procedure. The moisture content of the butter samples was determined by oven drying the sample at 104 °C and expressed as weight loss percentage. The solid-not-fat (SNF) content of the butter sample was determined by removing the fat portion of the butter sample with petroleum ether. The residue was dried and measured for the determination of solid nonfat (curd) in the sample. The fat content of butter was determined by measuring the moisture and SNF content of the butter sample and subtracting the percentage of these components from 100% to calculate the fat content by difference method. Butter Protein content was determined by the Kjeldahl method according to the AOAC official. 920.87 (AOAC, 2000).

3.3. Statistical Analysis

Survey data was subjected to statistical analysis using statistical package for social sciences software, version 20.0 (SPSS, 2002). The two *Woredas* were used as fixed factors for the various dependent variables assessed in the survey. Pearson chi-square test (χ^2) was used to compare discrete/categorical variables, while mean, percentage and standard error were used to examine differences between continuous variables. Differences were declared significant at $p < 0.05$. t - test was used for comparing the levels of physicochemical compositions of butter for the two *Woreda*.

4. RESULTS AND DISCUSSIONS

4.1. Socio-Economic Characteristics of Households

The result of the socio-demographic characteristics of respondents in the study sites is indicated in Table 2. The sex of respondents in the study areas was 100 % female in both *woredas*. Similarly, observation and study conducted in *Damot Woyde* district of Southern Ethiopia on the assessment of butter marketing system in the supply chain also revealed that 85 % of the respondents were female.

Table 2: Socio demographic characteristics of butter producers in the study area.

Variable	Woreda		X ²	p-value
	Mesela N (%) (N=63)	Tulo N (%) (N=77)		
Sex of respondents				
Male	-	-	-	-
Female	63(100)	77(100)		
Age of respondents				
Less than 30	4(6.3)	1(1.3)		
31-40	19(30.2)	27(35.1)	3.250	0.355
41-50	32(50.8)	36(46.8)		
Above 51	8(12.7)	13(16.9)		
Educational level				
Secondary school	4(6.3)	4(5.2)		
Junior school	1(1.6)	1(1.3)		
Elementary	15(23.8)	19(24.7)	0.175	0.996
Read and write	23(36.5)	27(35.1)		
Illiterate	20(31.7)	26(33.8)		

According to Amintu et al. (2016) women were entirely engage in butter processing and marketing in Southern Ethiopia. Besides, the current result is in agreement with a report of Alganesh *et al.* (2016) who revealed that 80 % and 13.3 % of dairy product processing, handling, and transportation activities are conducted by women and their daughters, respectively. This implied that butter production and handling is entirely the role of females. Age categories of the respondents showed that 6.3%, 30.2%, 50.8%, and 12.7% were less than 30, 31-40, 41-50, and

above 51 years old, respectively for *Mesela woreda*. In the same order, the age categories of respondents in *Tulo woreda* were 1.3%, 35.1%, 46.8%, and 16.9% in the ranges of less than 30, 31-40, 41-50, and above 51 years old, respectively. From the result, it can be observed that the majority of the respondents who are engaged in butter production, processing, and handling were in the productive age group of 31-50 years (Table 2). The current finding is in agreement with a similar study conducted in the *Dire Inchini* area of the West *Shewa* zone by Debela *et al.* (2016) who reported that 59.09% of respondents represented the productive age group of 19-59 years. A similar result was also reported from Southern Ethiopia in *Damot Woyde* district indicating that 88.3% of the respondents were in the age range of 31-35 years. Alganesh *et al.* (2020) has also reported that 55.7% of the respondents involved in butter production, processing, and handling were in the age range of 31-45 years.

The educational status of the respondents was 31.7%, 36.5%, 23.8%, 1.6%, and 6.3% for illiterate, read and write, attended elementary schools, junior school, and secondary schools, respectively in *Mesela woreda*. While in *Tulo woreda* 33.8%, 35.1%, 24.7%, 1.3% and 5.2% were illiterate, read and write, attended elementary schools, junior school and secondary schools, respectively (Table 2). The current report is different from a report of Belay and Janssens (2014) who reported that the majority (35.5%) of respondents in Jimma town had college-level education, while 24.1 % and 7.4% had senior secondary schools and university level education, respectively. The difference might be because urban residents have better access to education than rural dwellers. A similar report by Amistu *et al.* (2016) revealed that 75% of the respondents in the *Damot Woyde* district of Southern Ethiopia had at 5-8th grades. The same report from southern Ethiopia also revealed that 13.3% and 11.7% had certificate and diploma levels, respectively. Another similar study by Alganesh *et al.* (2020) also revealed that 71.3%, 23.3%, and 3.8% of the respondents in the enteral highlands and southwest midlands of Ethiopia were illiterate, attended elementary school, and secondary school, respectively. Farmers with more years of schooling can easily accept dairy advisory services and use more effectively than those who have lower education (Lemma *et al.*, 2012). However, 65.5% of the respondents in the current study are illiterate and the high level of illiteracy has negative impact on butter production, processing and handling in terms of production and delivery of safe and quality product in the supply chain. This could be associated with the fact that rural communities in the

country have generally less access to education, but it is usually their culture to rear cattle and produce dairy products including butter.

4.2. Family size and number of dairy cows per household

The average family size in the study area was $5.65 \pm .305$ and $6.74 \pm .35$ (mean \pm SE) in the *Mesela* and *Tulo woredas*, respectively (Table 3). The overall mean of family size per household was $6.69 \pm .191$ (mean \pm SE) which is higher than the national average (5.2), as reported by (CSA, 2022). There is a significant difference between *woredas* ($P < 0.05$). The family size observed in this study was comparable with the finding of Adinew (2016) who reported that the average family size of the Mieso district was 6.62, and with also that of Belay (2015) who reported, that the mean family size was 6.77 people/households in Horoguduro, Eastern Wollega Zone. The larger family size in study areas implies that these HHs have good sources of family labor to utilize for different activities such as butter production, processing, and handling.

Table 3: Family size and number of dairy cows per household

Variables	Statistical measures	Woreda		Overall	p-value
		Mesela	Tulo		
Family size	Mean \pm SE	$5.65 \pm .315$	$6.74 \pm .353$	$6.69 \pm .191$	0.002*
Number of dairy cows per households	Mean \pm SE	$2.24 \pm .129$	$2.61 \pm .142$	$2.32 \pm .071$	0.015*

Regarding dairy cow holding capacity per household, the result revealed that the average number of dairy cows per household in the study area was $2.24 \pm .129$ and $2.61 \pm .142$ (mean \pm SE) in the *Mesela* and *Tulo woredas*, respectively (Table 3). The overall number of dairy cows per household was $2.32 \pm .071$ (mean \pm SE). There is a significant difference between *woredas* ($P < 0.05$). The current study result is higher than the report of Mulu (2016) in the *Meta Woreda*, East Hararghe Zone, who reported that the average dairy cattle holding was 1.147 ± 0.35 per household. However, this study result was less than the report of Melku (2016) in West Gojam Zone, and Kassu, (2016) in Bona Zuria Woreda of Sidama Zone who reported 9.8 and 7.10 ± 0.59 cattle per household, respectively.

4.3. Types of churners used for making butter

In *Mesela woreda*, 47.6 % of the respondents indicated that bottle guard churners were used for butter making. While more than 52.4% of them indicated that plastic churners were used for the same purpose (Table 4). In *Tulo woreda*, 49.4% of the respondents reported that bottle guard churners were used for butter making while 50.6% of the respondents reported that plastic churners were used for butter making. The respondents in the study areas faced different constraints on butter processing steps like easy breakage of processing utensils, long time taking, and being very laborious. Therefore, the introduction and demonstrations of improved churners are recommended to minimize the workload of women and increase butter-making efficiency. Tseday and Bereket (2016) also confirmed that 40% and 4.2% of smallholder dairy producers in southern Ethiopia used clay pots and gourds for churning, respectively. While, in the Gurage zone only clay pots were used for churning (Abebe *et al.*, 2013). Alganesh *et al.* (2020) in the Wolmera *woreda*, 96% of the respondents used clay pot churners for butter making while only 4% of the respondents used electrical and improved manual churners. The traditional churning method is generally time-consuming and labor-intensive and results in the loss of high fat in buttermilk (Abebe *et al.*, 2018). Besides, local churners are not easy to clean and sanitize, they form biofilms and easily harbor microorganisms (microorganisms affect the safety and quality of dairy products) (Abebe *et al.*, 2018).

Table 4: Types of churning materials in the study areas

Types of churning material	Woredas		X ²	p-value
	Mesela N (%) (N=63)	Tulo N (%) (N=77)		
Bottle guard	30(47.6)	38(49.4)	0.042 ^a	0.838
Plastic	33(52.4)	39(50.6)		

4.4. Uses of Butter, Frequency of Butter Making, Length of Milk Fermentation, Volume of Milk Processed and Butter Yield.

4.4.1. Uses of Butter

Butter making is among the common milk processing practices in the study areas. About 60.3% and 64.9% of the respondents in the *Mesela* and *Tulo* woredas, respectively utilize butter for cosmetics purposes (Table 5). The interviewed households mentioned that the one they use for cosmetics purposes is after what remains from sale and home consumption. Moreover, 39.7% and 32.5% of respondents in the *Mesela* and *Tulo woredas* among the interviewed households mentioned that they utilize butter only as cooking fat, respectively. Additionally, about 0 and 2.6% of respondents interviewed in *Mesela* and *Tulo woreda*, respectively indicated that they use the produced butter for taken in coffee. Eyasu and Asaminew (2014) also reported that butter is used for cooking, income generation, and hairdressing mainly by female members of households in north-western Ethiopia. Alganesh *et al.* (2020) in the *Wolmera woreda* also reported that butter was added to coffee or tea and drunk to get relief from common colds and coughs. Zelalem *et al.* (2011) also reported that butter is used for home consumption (87%), income generation (10%), and other purposes (3%).

Table 5: Length of milk fermentation, volume of milk processed and frequency of butter production from single churn in *Mesela* and *Tulo Woreda*

Variables	Woreda				X ²	p-value
	Mesela		Tulo			
	Frequency	Percent	Frequency	Percent		
Length of milk fermentation (days)						
Three days	56	89	71	92	0.45	0.501
four days	7	11	6	8		
Volume of milk processed (liters)						
Less than 1	5	7.9	16	20.8	15.99	0.001
2-4	32	50.8	39	50.6		
4-5	14	22.2	21	27.3		
Above 5	12	19	1	1.3		
Milk processing frequency/ week						
Twice A Week	51	81	69	89.6	2.12	0.145
Once Per Week	12	19	8	10.4		
Butter yield (kg)						
Less than 0.1	5	7.9	17	22.1	22.66 ^a	0.000
0.2-0.4	33	52.4	51	66.2		
0.4-0.5	12	19	9	11.7		
Above 0.5	13	20.6	0	0		

4.4.2. Frequency of Butter making

The frequency of local butter production in the study areas depends upon the volume of milk accumulated per week and the extent of fermentation conditions. The frequency of the production varied from one to three times per week (Table 5). More than 85.7% and 14.3% of the respondents in the study area indicated that butter was made twice and once per week. In *Mesela woreda*, 81.0% and 19.0% of the respondents indicated that butter was produced twice and once per week, respectively.

In *Tulo woreda*, butter was made twice and once per week was 89.6% and 10.4% of the respondents, respectively. The current result aligns with Yitaye *et al.*, (2009); and Tsegaye and Gebre-egziabher (2015) who indicated that 100% of households produced butter 2-3 times a week. Mekdes (2008) also indicated that 33% and 36% of respondents in southern Ethiopia

made butter every day and four times a week, respectively. Sale *et al.* (2018) from Amhara region showed that 47% of respondents made butter twice a week. The current finding is also in line with Tseday and Bereket (2016) who indicated that the frequency of butter making mainly depends on the temperature of an area and souring time of milk. The frequency of butter production depends on the quantity of daily collection of milk, reasons for milk processing, the presence or absence of a market for fresh milk, the quantity of fresh and fermented milk consumed by the farm households, and the ambient temperature at which spontaneous fermentation occurs. Besides, the frequency of butter making by smallholder producers depends on the size of production or number of milking cows.

4.4.3. Length of Milk Fermentation

As shown in Table 5, the majority of the respondents in the *Mesela woreda* (89%) reported that milk was left to sour for 3 days while 11% of the respondents reported that milk was left to sour for 4 days. Similarly, the majority of the respondents in *Tulo woreda* (92%) reported that milk was left to sour for 3 days, while 8% of the respondents reported that milk was left to sour for 4 days. This result aligns with the findings of Belay and Janssens (2014) who reported that the majority of the respondents (86%) reported that milk was left to sour for 3 days. The duration of spontaneous milk fermentation depends on the quantity of back slop used, the temperature of milk storage, and the season of the year. Fermentation time becomes longer during the rainy season compared to the dry season.

4.4.4. Volume of Milk Processed

50.8% and 50.6% of the respondents in *Mesela* and *Tulo woredas*, respectively process on average 2-4 liters of milk at a time, whereas 22.2% and 27.3% of the respondents in *Mesela* and *Tulo woredas*, respectively process on average 4-5 liters of milk at a time. This result is slightly less than the findings of Belay and Janssens (2014) who reported that 62% of the households process on average five liters of milk at a time.

4.4.5. Butter Yield

The results indicates a highly significant difference in the amount of butter produced from single churn between the two districts. In Mesela, 20.6% of farmers produce over 0.5kg of butter, while in Tullo, none do. A greater proportion of Tullo farmers produce less than 0.1kg of butter compared to Mesela.

4.5. Butter Handling Practices

About 39.7% and 45.4% of the respondent in Mesela and Tulo Woredas, respectively used Sheketi (traditionally prepared equipment) to handle butter. Moreover, 19.0% and 23.4% of the respondents in Mesela and Tulo Woredas, mentioned that plant leaf (gulo) used to handle butter after churn.

Table 6: Equipment Used to Handle Butter

Variables	Categories	Woreda		X ² -value	P value
		Mesela	Tulo		
		N(63)	N(77)		
		N (%)	N (%)		
Material (Equipment) used to handle butter	Plastic container	10(15.9%)	12(15.6%)	2.242*	0.524
	Aluminum container	16(26.4%)	12(15.6%)		
	Plant leaf	12(19.0%)	18(23.4%)		
	Sheketi (traditional equipment)	25(39.7%)	35(45.4%)		

4.6. Butter Marketing Practices

Responsibility to sell butter, equipment used to measure, buyer of produced butter and quality factors indicated in the table 7. As the result indicated 100%, females have responsibility to sell butter both in Mesela and Tulo Woreda.

Table 7: Responsibility to sell butter, Equipment used to measure, Buyer (Customer) and Quality factors Buyer Conceder to Buy Butter

Variables	Categories	Woreda		X ² value	P value
		Mesela N(63)	Tulo N(77)		
Responsibility to sell butter	Housewife	46(73.0%)	60(77.9%)	0.434*	0.317
	Daughter	17(27.0%)	17(22.1%)		
Equipment used to measure	Cap	7(11.1%)	21(27.3%)	5.651*	0.014
	Lamba (Tomatoes paste can)	56(88.9%)	56(72.7%)		
Butter Buyer	Consumer	22(34.9%)	26(33.8%)	0.020*	0.514
	Trader	41(65.1%)	51(66.2%)		
Quality Factors Buyer Considered to buy	Color	24(38.1%)	21(27.3%)	1.861*	0.119
	Freshness	39(61.9%)	56(72.7%)		

11.1% and 88.9% of the respondents in Mesela Woreda were indicated that cup and lamba (tomato paste can) used to measure butter during selling. In Tulo Woreda 27.3% and 72.7% of the respondent were indicated that cup and lamba (tomato paste can) used to measure butter. There is significant deference between the two Woreda at ($p < 0.05$).

In Mesela and Tulo 34.9% and 33.8% of the respondents indicated that consumer buy traditionally produced butter, respectively. Accordingly 65.1% and 72.7% of the respondents in both Woreda indicated that trader buy their butter. The result reported by Kasu (2016) indicated that 79.3% consumer and 20.7% trader bought produced in Bona zuria district of Sidama zone.

61.9% and 72.7% of the respondents in Mesela and Tulo Woreda were indicated that freshness is the quality factor buyer to buy traditionally produced butter, respectively. On the other hand 31.8% and 27.3% of the respondents in Mesela and Tulo Woreda were indicated that color is quality factor.

4.7. Physico-chemical Property of Butter

As shown in the Table 6 the mean value of moisture content in the two Woreda was 18.19 ± 0.53 and 18.67 ± 0.53 in the *Mesela* and *Tulo Woreda*, respectively with an overall mean value of 18.43 ± 0.37 . There were no significant differences in moisture content between Woreda ($P > 0.05$,

at 95 %CI). This result aligns with the findings of Mekdes (2008) who reported that the average moisture content of (18.86%) per gram of butter samples collected from open markets of Delbo and Kucha, Ethiopia. However, higher than the value of Ashenafi (2008), Lina *et al.*, (2018), and Shitaye *et al.* (2018). The moisture content of traditional Ethiopian butter ranges from 20 to 40% compared to the international standard butter value of 16 % Tolosa (2016). The moisture contents of butter samples from both *Mesela* and *Tulo Woreda* are higher than the standard reference set by the international standard butter value of 16 % that set by the National Standard of Food Safety of People’s Republic of China (GB/19646-2010). The mean fat content of butter collected from the *Mesela* and *Tulo woredas* were 77.91 ± 0.50 and 78.64 ± 0.50 , respectively with an overall mean of 78.27 ± 0.36 (Table 6). There were no significant differences in fat contents between *woredas* ($P>0.05$, at 95 %CI). A slightly lower fat contents in both butter samples were obtained as compared with reports from similar investigation with fat content ranges from 81.2 to 83.72 % (Zelalem, 1999; Ashenafi, 2006; Lina *et al.*, 2018; Shitaye *et al.*, 2018).

Table 8: Physicochemical properties of butter from Mesela and Tulo woredas.

Variable	Woreda			
	<i>Mesela</i>	<i>Tulo</i>	over all mean	
	LSM±SE	LSM±SE	LSM±SE	t-value
Moisture	18.19±0.53	18.67±0.53	18.43±0.37	0.522
Fat	77.91±0.50	78.64±0.50	78.27±0.36	0.316
Crude Protein	2.40±0.1	2.42±0.1	2.4±0.06	0.879
Total Ash	0.26±0.06	0.39±0.06	0.32±0.05	0.189
Solid nonfat	3.09±0.16	3.45±0.16	3.27±0.2	0.13

The result indicates that butter in the two *woredas* has lower fat content which is not in agreement with the permissible level of fat content in butter, which indicate the recommended minimum level should be 82 % as reported by FAO/WHO (2007). Traditionally and legally, however, butter must contain >81% of only milk fat (Gebremedhin *et al.*, 2014).

The solid not fat (SNF) content of butter from Mesela and Tulo were 3.09 ± 0.16 and $3.45\pm 0.16\%$, respectively with an overall mean of $3.27\pm 0.2\%$ (Table 6). There were no significant differences in solid nonfat (SNF) contents between *woredas* ($P>0.05$, at 95 %CI). Numerically, higher solid not fat content was recorded for the Tulo butter sample compared with butter samples from

Mesela woreda. From the analysis of solid not fat value from *Mesela* and *Tulo Woreda*, butter samples were above the permissible limit (2 %) Van den Berg (1988). A slightly lower solid not fat (SNF) content in both butter samples were obtained as compared with reports from similar investigation by (Lina *et al.*, 2018; Shitaye *et al.*,2018).

The crude protein content of butter from *Mesela* and *Tulo* were 2.40 ± 0.1 and 2.42 ± 0.1 %, respectively with an overall mean of 2.4 ± 0.06 % (Table 6). There were no significant differences in protein contents between *woredas* ($P>0.05$, at 95 %CI). The protein contents of butter samples investigated have showed comparatively higher values than the report of (Ashenafi 2006; Lina *et al.*, 2018; Shitaye *et al.*, 2018). The values of crude protein obtained in this study were found to be higher than the permissible level set by FAO/WHO (2007), which states that, the crude protein level in animal fat (butter) should not exceed 0.85 %.

As indicated in Table 6, the average ash content of 0.26 ± 0.06 and 0.39 ± 0.06 were found in butter sample from *Mesela* and *Tulo woredas*, respectively. There were no significant differences in ash contents between *woredas* ($P>0.05$, at 95 %CI). The ash contents obtained from both samples are in comparable with the reported value of (Mekdes, 2008; Lina *et al.*, 2018; Shitaye *et al.*, 2018). The data obtained in this investigation for %Ash contents of butter from *Mesela* and *Tulo woredas* are not in agreement with the standard reference value of 0.09 % (USDA, 2018).

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary and Conclusions

The main objective of this study was to assess traditional butter production, handling, marketing, and physicochemical properties in *Tullo* and *Mesela Woreda*. To fulfil this the data on the Assessment of Traditional Butter Production, Handling, and Marketing was collected from 140 producers (63 from Mesela and 77 from Tullo). The butter samples for determination of butter physiochemical properties were collected from 30 respondents who participated in the survey. The socio-economic characteristics of households shows that all butter producers were female, with most in the productive age range of 31-50 years. Educational levels revealed high illiteracy rates (32-34%), limiting the ability of households to adopt modern dairy practices. Family sizes averaged 5.65 and 6.74 members in Mesela and Tullo, respectively, providing labour for butter production. Households owned an average of 2.32 dairy cows, with significant differences between districts.

Traditional butter making methods (churning) dominate, with plastic (gallon) churners slightly more common than bottle gourds. Butter is primarily produced for sale, households. Consumption, and cosmetics, with production happening once or twice a week. Fermentation times typically lasted three days, and on average, 2-4 litter of milk were processed at a time. The physio-chemical analysis of butter indicates that moisture and fat content were not within acceptable range. The crude protein content was higher than permissible levels, indicating lower purity. The ash content was also above standard references, while solid non-fat content was within acceptable limits

The study indicates that butter production in *Mesela and Tullo Woreda* is totally female activity, with the majority of producers in the productive age group but facing challenges related to illiteracy. Butter is mainly produced for marketing, cosmetics and household uses, with significant variations in production frequency and fermentation times. While the physio-chemical properties of butter are within certain acceptable ranges, some deviations, such as higher protein and ash contents, suggest potential quality and safety concerns.

5.2. Recommendation

- Efforts should be made to improve literacy and awareness among butter producers, especially on modern dairy handling and processing practices. This could help improve product quality and safety.
- Introducing modern, efficient churners could reduce the labor-intensive process and improve production efficiency, especially for women engaged in butter making.
- Regular training on butter production is important to ensure butter meets both local and international standards.
- Producers need to have access and link with the market to sell their product at better prices.
- Further research are recommended to improve butter production system, handling and marketing system in the *woredas*.

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7. APPEDIX

Survey Questionnaire

Questionnaire on traditional butter production, handling and marketing in Tullo and Mesela Woreda

1. Smallholder farmers (producers)

Name of data collector ----- Date -----

Name of respondents----- Zone-----

District/Woreda----- Kebele-----

2. Demographic characteristics (Encircle, tick or fill as appropriate)

1. Age of respondent. 1. Less than 30 2. 31-40 3. 41-50 4. above 50

2. Sex of respondent. a. Male b. Female

3. Educational level of respondent. a. Secondary school b. Junior school c. Elementary school d. Read and write e. Illiterate

4. Family size (number)

1. Less than 3 2. 4-6 3. 7-10 4. above 10

5. Cattle holding (number)

1. 2-3 2. 4-6 3. Above 6

6. Number of cows milking (number)

1. 1 2. 2 3. 3 4. 4

3. Milk Processing practice

1. Do you process milk? a. yes b. no

2. Who is responsible for milk processing? a. housewife b. daughter c. son d. husband

3. What is the base of processing? a. whole milk b. cream c. fermented milk/ergo

4. What matters whether the processing is ready or not? a. milk volume b. physical compactness milk

5. What are the major products processed in your home? a. ergo b. butter c. defatted sour milk d. ayib e. whey

6. How frequent do you churn/process? a. daily b. twice a week c. once per week

8. Types of equipment used for milk fermenting? a. clay pot b. metal (aluminum)
c. plastic container d. keba (kedada)
9. How many liters of sour milk churned at a time in liters 1. less than 1 2. 2-4 3. 4-5 4.
Above 4
10. How much butter is produced in a single churn in kg 1. Less than 0 .1 2. .2-.3
3.31-.5 4. Above .5
11. What types of churning material do you use? a. bottle guard
(diro) b.. plastic (gallon) c. Clay pot
12. Do you wash butter after churning? a. yes b. no
13. What types of plant use for smoking to the milk utensils and churner? a. Woira (Olea
africana) b. Biressa c. Rukessa
14. Do you wash your hand before subjecting to handle butter? a. yes b. no

4. Butter handling practices

1. What material do you use to handle butter just after churning? a. plastic container b.
aluminum container c. plant leaf (**specify**.....) d. cup e. sheketi
2. How long do you store in the material you choose above? a. for a day b. for a week c. for
month

5. Milk and Butter consumption

1. Do you consume butter? a. yes b. no
2. If **No**, what are the reasons? a. fasting b. high demand and price of butter
c. shortage of butter supply
3. How do you consume butter? a. fresh butter b. fresh butter treated with spice
c. cooked fresh butter d. cooked treated butter with spice
4. For what purposes do you use butter within the family a. Taken in coffee b. As cooking
fat c. As cosmetic e. As medicine

6. Marketing of butter

1. Do you sell butter a. yes b. no
2. Who is responsible for butter marketing? a. housewife b. husband c. daughter
d. son
4. What measurement do you use when selling? a. Cup (lemba) b. kg c. Other
5. Who buy your butter? a. consumer b. trader

6. Where do you sell butter? a. at market b. at house
7. What quality factors do consumers or trader consider while buying your butter?
- a. color b. odor c. freshness d. low cost

.....THANK YOU.....

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.704 ^a	1	.402	.421	.262
Continuity Correction ^b	.402	1	.526		
Likelihood Ratio	.701	1	.403		
Fisher's Exact Test					
Linear-by-Linear Association	.698	1	.403		
N of Valid Cases	140				

Appendix Table 1: Sex of Respondents

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.250 ^a	3	.355
Likelihood Ratio	3.361	3	.339
Linear-by-Linear Association	.541	1	.462
N of Valid Cases	140		

Appendix Table 2. Age of Respondents

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.175 ^a	4	.996
Likelihood Ratio	.175	4	.996
Linear-by-Linear Association	.082	1	.774
N of Valid Cases	140		

Appendix Table 3. Educational level of Respondents

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.296 ^a	3	.348
Likelihood Ratio	3.685	3	.298
Linear-by-Linear Association	1.751	1	.186
N of Valid Cases	140		

Appendix Table 4. Family size

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.059 ^a	2	.011
Likelihood Ratio	10.946	2	.004
Linear-by-Linear Association	7.745	1	.005
N of Valid Cases	140		

Appendix Table 5. Number of milking cows

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.658 ^a	3	.000
Likelihood Ratio	27.853	3	.000
Linear-by-Linear Association	20.961	1	.000
N of Valid Cases	140		

Appendix Table 7. Butter yield in a single churn in kg

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.919 ^a	3	.001
Likelihood Ratio	17.729	3	.001
Linear-by-Linear Association	9.346	1	.002
N of Valid Cases	140		

Appendix Table 6. Volume of sour milk churned at a time

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	3.492 ^a	1	.062		
Continuity Correction ^b	2.514	1	.113		
Likelihood Ratio	3.743	1	.053		
Fisher's Exact Test				.089	.054
Linear-by-Linear Association	3.467	1	.063		
N of Valid Cases	140				

Appendix Table 8. Who is responsible for milk processing?

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	2.121 ^a	1	.145		
Continuity Correction ^b	1.473	1	.225		
Likelihood Ratio	2.113	1	.146		
Fisher's Exact Test				.155	.113
Linear-by-Linear Association	2.106	1	.147		
N of Valid Cases	140				

Appendix Table 9. Frequency of churning /process?

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2- sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.042 ^a	1	.838		
Continuity Correction ^b	.001	1	.973		
Likelihood Ratio	.042	1	.838		
Fisher's Exact Test				.866	.487
Linear-by-Linear Association	.041	1	.839		
N of Valid Cases	140				

Appendix Table 10. Types of churning materials.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.259 ^a	2	.323
Likelihood Ratio	3.012	2	.222
Linear-by-Linear Association	.053	1	.818
N of Valid Cases	140		

Appendix Table 11. Use butter within the family.



Appendix Figure 1: Traditional method of butter marketing



Appendix Figure 2: Traditional butter production



Appendix Figure 3: During laboratory analysis



Appendix Figure 4: Butter Sample in Ice box