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Review on Quality and Safety of Edible Oil in Ethiopia

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1. Abstract

Food safety is a significant barrier to social and economic development throughout the world, particularly in developing countries. Here, we reviewed the physico chemical and microbial quality and safety of samples collected from different city in Ethiopia (local and imported edible oil) which is in the rapidly growing Ethiopian edible oil supply-chain. According to the research report majority (above 98%) of Edible oil samples had quality and safety problems (physico chemical and microbial safety). Comparing to the international standards (WHO, FAO, CODEX210-1999, CODEX STAN210-1999) Except one research report all had physico chemical and microbial safety problems for all site collected edible oil samples. Implementation of good hygiene and production practices is needed to inform larger coordinated efforts focused on improvement of edible oil safety in Ethiopia. Local millers should take care of on edible oil processing specially the government should implement the quality and safety management system in the country as well as motivating investors to participate and build refined technology for edible oil production in Ethiopia.

2. Introduction

In the web of world's food supply oil crops and their oils have the highest rank and is the second most valuable commodity in the world food trade [40]. The most common edible oils in Ethiopia are of two types. These are the imported and the one locally produced. The common edible oils currently in Ethiopian markets are vegetable oils such as palm oil, sesame seed oil, soya bean oil, sunflower seed oil and groundnut seed oil [24].

Ethiopia has favorable agro-climatic conditions for cultivation of oil seeds as well as one of the centers of origins for several oil crops such as sesame, Niger seed, soybean, sunflower and cotton seeds (Edible Oil Value Chain Enhancement JP Final Evaluation-Report,2013)[1]. The quality of edible oil is a measure of identity. In the developed world quality of edible oils are highly established and controlled but in developing countries food safety and quality are poorly managed. Edible oils are among the most abundant cooking ingredients that contain essential fatty acids that are responsible for growth and carriers of fat soluble vitamins (A, D, E, and K) [20].

There are about 850 small-scale and micro oil processing plants in Ethiopia (Edible Oil Value Chain Enhancement JP Final Evaluation report, 2013) [2]. They produce sealed or unsealed forms of oils. Mostly these oils pass through some form of preparation before being consumed for reasons such as safety, palatability, texture, flavor, to enhance the taste, and to increase the shelf life of the oils [25]. As a result, many unnecessary changes occur in these products that reduce their nutritional qualities [25]. Hence, extraction of edible oils needs carful processing in order to avoid the co-extraction of unnecessary components.

Microorganisms are also known to cause chemical changes in edible oil that lead to deterioration in the quality of the edible oil which can cause serious health impacts and death. The lipolytic activity of fungus on the triglycerides of oils and fats used in cooking formulations causes rancidity, acidity, bitterness, soapiness and other off flavors. Hence, extraction of edible oils needs carful processing in order to avoid the co-extraction of unnecessary components and Microbial contamination of edible oil is the most common health risk. Food processors and handlers with very poor personal hygiene and inadequate knowledge of food safety and quality could be the source of pathogen.

Figure 1: Different Edible oil types used for research by the researchers from the Research Report

This review of published peer-reviewed literature reporting the quality and safety of Edible oil in the rapidly growing Ethiopian edible oil supply chain carried out to provide a summary of the edible oil quality and safety from the different research report. The data reported here used to inform future food safety interventions aimed at reduction of the incidence of food borne illness as well as CVD due to exposure to pathogens and chemical deterioration of oil through different factors in Ethiopia.

3. Ethiopia's Edible Oil Supply Chain

Ethiopia's oilseed sector plays an important role in generating foreign exchange earnings. The three major oilseed crops (sesame, soybean, and niger seed) contribute to nearly 20% of Ethiopia's total agricultural export earnings, second to coffee. In the Year 2018/19 (Oct-Sep), exports of sesame, Niger seed, and soybeans generated nearly $430 million in export earnings.

In addition, the oilseed sector provides income to millions of growers and others market actors along the value chain. The production of sesame, Niger seed and soybean is estimated to increase in Main season Year 2019/20 (Oct-Sep) on average by seven percent over last year. Looking ahead, Post expects production of soybeans and Niger seed to increase to meet the growing demand for cooking oil (ECX,2020) Report.

Ethiopia has a large number of local small scall processors. The annual domestic production ranges from 5000 to 8000 tons for the medium and large scale enterprise. This production is estimated to be less than half of the full capacity. So the country imports various oils such as palm oil, soya seed [54]. Due to the above reasons and not having refining technology in Ethiopia edible oil quality and safety exposed to Physico chemical and microbial safety problem.

Table 1: Estimated Production Volume of Major Oilseeds (metric tons) from 2018-2019 in Ethiopia

crop	2018/2019	2019/2020	Value change	Volume change
Sesame	300,000	340,000	40,000	13%
Niger seed	300,000	305,000	5000	2%
soybean	190	200,000	10,000	5%
Total	790,000	845,000	55,000	7%

Table 2: Major oil seeds Crushed by local miller in Ethiopia

Crop	Crushed by local miller (Percentage)
Noug	85%
groundnut	35%
Sunflower	32%
Linseed	25%
Rapseed	10%

Table 3: Reason for not having refining technology in Ethiopia

Resean	Percentage
Affordability /Accessibility	68%
Consumer preference for crude oil	65%
Reliability	15%

3.1. Edible Oil Quality, Safety and Associated Health Risk

Edible oil, as the energy source of human body nutrition, is a very important part of human diet and an essential raw material in food processing industry. The edible oil plays a very important role in our daily life. The quality and safety of edible oil can easily be affected by many factors including methods of oil production and processing, distribution and catering services, food additives and food production as well as packaging materials. Edible oil serves as membrane bilayer and sources of energy [26]. Fatty acids are triglyceride molecules which are composed of three fatty acid units connected to a glycerol. The fatty acid chains attached to the glycerol units can be identical or different depending on this Fatty acids are unsaturated (oleic, linoleic, linolenic etc. acids) or saturated (myristic, palmitic, stearic acid).

According to the joint WHO/FAO report, the dietary Trans Fatty Acids (TFAs) and SFAs have adverse effects on blood lipoprotein profiles and Coronary Heart Diseases (CHD) [31, 51]. The nutritional values of oils and associated health risks can be determined by calculating the ratio of poly unsaturated to saturated fatty acids (P/S index values). Oils and fats with P/S index value higher than one are considered to have healthy nutritional values [32]. Higher values of P/S index indicate a smaller deposition of lipids in the body (Lawton et al., 2000). Seriously, cardiovascular diseases have been documented to be the main cause of death in most Western countries [10]

Table 4: annual edible oil import volume (ton) Jan-Dec

Commodity	2017	2018	2019
Palm oil	358751	76502	27806
Sunflower oil	37950	56175	158822
Soya bean oil	2923	3686	3442
Olive oil	374	366	446
other	125	40	85
total	400123	136769	190601

Table 5: edible oil quality standards
Source: (JOINT FAO/WHO FOOD.,2019)

Parameter	**Max, range**
1.Referactive index(40^{0}C)	1.46-1.473
2.Saponification value(mgKoH/g oil)	180-195
3.Iodine value	90-115
4.Unsaponifable matter(g/kg)	<50
5.Cholestrol	ND-0.5
6.P/S	>1
7.Fe	Max 1.5 mg/Kg
8.Pb	Max. 0.1 mg/kg
9.Ar	Max. 0.1 mg/kg

Table 6: Experimental design and reviewed study that reported the physico chemical quality and safety of edible oil in Ethiopia

Reference	Region	Town	date	Place Of sampling	Study design	Sample size	Detection method	Permissible limit Compared to the standards
Tesfamichale and Ele,2016	Ethiopia	Addis Ababa	2016	Addis Ababa (Imported and local)	Not stated	23	Fatty acid by GCMS	Within the allowable limit of WHO/ FAO standards
Habte et al., 2016	Ethiopia	Addis Ababa	2016	Addis Ababa	Not stated	16	Using standard methods	by pass the WHO daily recommendation amount
Negash et al.,2019	Ethiopia, Amahara	Gonder	2019	Gonder city (Imported and local)	Cross sectional	60	Official analysis methods (MC, specific gravity, peroxide value ,acid value, iodine vale)	Rancidity-local samples were more than the WHO/WHO standards Imported samples greater fatty cid saturation/not within the agreement to WHO/FAO standards
Alemayhu et al., 2019	Ethiopia	Addis Ababa	2019	Ethiopia	Not stated	3	Accelerated shelf life testing Method/ GCMS	For all samples Peroxide value within the agreement to (CODEX210-1999) For all samples Others parameters not within the agreement of (CODEX210-1999).
Atinafu and Bedemo,2011	Ethiopia, Amahara	Bahir Dar	2011	Bahir Dar,	Not stated	9	Liebermann Burchared method	All samples More than the standards (CODEX STAN210-1999) Except peroxide value.
Tesfaye and Abebaw, 2016	Ethiopia, oromia	ambo	2016	Ambo (Local and imported)	Not stated	4	AAS and wet chemical method	Within the allowable limit of WHO/ FAO standards

Table 7: Experimental design and reviewed study that reported the Microbial quality and safety of edible oil in Ethiopia

Reference	Region	Town	date	Place Of sampling	Study design	Sample size	Detection method	Permissible limit Compared to the standards
Chen et al., 2019	Ethiopia, Amahara	Gonder	2019	Gonder city(Imported and local)	Not stated	48	MS/MS/official analysis method	Above the allowable limit of WHO/FAO standard
Gobena et al., 2018	Ethiopia	Addis Ababa	2018	Ethiopia	Retrospective	125	Official analysis methods	Compared to other study the result were high microbial load.
Tesfaye et al.,2015	Ethiopia, Amahara	Gonder	2019	Gonder city(Imported and local)	Not stated	50	Official analysis methods	Samples had greater result ,not within the agreement to WHO/FAO standards

4. Edible Oil Quality and Safety in Ethiopia

4.1 Physicochemical Quality and Safety of Edible Oil

Fatty Acids (FAs) are classified as SFA, MUFA and PUFA. Most of them are important to humans when they consumed safely and in the right amount [9]. In Ethiopia research related to saturated and unsaturated fatty acid reported a study sample size(n=23) edible oil (Niger edible oil, Sunflower edible oil, olive oil, palm oil, cotton seed oil and soya bean edible oil) According to the report done variation in identities and concentrations of fatty acids observed in all edible oil samples. Depending on the type and brand of the oils, the concentrations ranged saturated fatty acids (SFA) (9.92 %- 47%), (MUFA) (24.54% - 66.84%), and Poly Unsaturated Fatty Acids (PUFA) (7.23% - 59.11%) according to the study done by [8].

The SFA contents observed in these edible oils are slightly higher than the previous reports [29]. Results of SFA and PUFA of this oil are slightly higher than previously published data [57, 52, 32]. While its MUFA contents is slightly less from the report of [57, 52, 32]. From this the ratio of P/S The range were (Palm oil 0.18%-Sunflower oil 4.4%) and average lowest P/S index value was measured in palm edible oils (0.18) followed by olive edible oil (0.86). These values are closer to results reported by [32]. In general, the SFA, MUFA and PUFA results of this oil are within the range of Codex [11].

In quality control of Edible oil different parameters measured to control the quality of the manufactured edible oil in the factory, parameters such as iodine value (degree of unsaturation), peroxide value (formation of primary oxidation products), moisture content, specific gravity (purity), and acid value (free fatty acids formation because of rancidity) are key parameters to determine the shelf-life quality and hence the economic value of oils [16]. Rancidity of vegetable oils cause health risks including cancer and inflammation because of the formation of toxic and reactive oxidation products [34]. For healthy consumption, unsaturated oils are better than the saturated. Consumption of palmitic oil (highly saturated) is associated with an increased risk of developing cardiovascular diseases (Mukherjee and Mitra,2009). In contrast, edible vegetable oils such as sunflower, olive, canola and Niger-seed oils contain high levels of polyunsaturated fats [22] which make them susceptible for rancidity.

In one of the research study report in Ethiopia A total of sample size (n=60) samples 30 from locally made (Niger seed at market 14, Niger seed at production center 11, sunflower at the market 5) and 30 from imported palm oil brands (Avena 11, Hayat 4, Jersey 5 and Chef 10).The report from this study; Moister content were ranged (0.089%)- 0.333%) and specific-gravity (0.807 - 0.823), peroxide value (7.05 -15.09 mill-equivalents of oxygen/kg), acid value (0.98-2.43 mg KOH/g oil) and iodine value (115.63 -21.8 g I2/100 g oil) done by for local and imported edible oils, respectively(Negash et al., 2019).

Previous studies found that oils which were produced using low technology displayed a higher moisture. The higher moisture content in the locally made oils indicated that it undergo rancidity. This is because the presence of sufficient amount of moisture favors microbial growth [27] . Other studies have also shown that fungus species such as Aspergillus niger and Mucor species survive and reproduce when the moisture content value is higher than 0.2% [30].

The results highlight that all rancidity quality parameters of the locally made oil samples were not within the joint WHO/FAO standards while the imported oils showed greater fatty acid saturation. In this study, the mean value (0.823) of specific gravity for locally made oils was not in line with the WHO limit (Niger seed 0.917–0.92; Sunflower 0.919–0.923) [12]. The specific gravity value which deviated from the standards related to the poor refining and upgrading process in the local production facilities. Insufficient refining process lead for a higher impure oil grade [43] Furthermore, the specific gravity values of the locally made oils were below the standard ranges make them susceptible to adulteration [41].

High cholesterol content associated with chronic heart disease and other heart problems. However, cholesterol also has essential functions in the body such as providing essential components of membrane and serving as a precursor of bile acids, steroid hormones and vitamin D. Consuming cholesterol in our diet increases the level of Low Density Lipoproteins (LDLs). In one of outlined study in Ethiopia a total of sample size (n=9) nine samples of edible vegetable oils of which six are branded and three are non-branded. From this report Cholesterol was found in seven of the vegetable oils while for two oil samples (Niger seed k-16 and Niger seed k-7) it was not found (nil). Rapeseed branded vegetable oil had highest cholesterol concentration (257.1 mg/L) while branded palm oil has the least concentration (88.8mg/L) of cholesterol According to the report done by [4]. Niger seed had high content of the essential fatty acid; linoleic (C18:2) acid, which has the ability to decrease cholesterol levels, stimulate cholesterol excretion into the intestine and inhibit biosynthesis of cholesterol in the liver. Oils containing high level of polyunsaturated fatty acid are found to inhibit the activity of hydroxymethylglutaryl-coenzymeA-reductase (HMG-CoA-reductase) which is the regulatory enzyme in cholesterol biosynthesis.

Finding from above study supports previous work that cholesterol is present in vegetable oils, although in small proportion [45] Unlike the peroxide value, all the acid values and some saponification values show high values in comparison with the maximum permissibility level of codex standard for named vegetable oils [12]. Finding from this study supports previous work that cholesterol is present in vegetable oils, although in small proportion.

Several factors affect the edible oil quality such as agronomic techniques, seasonal conditions, sanitary state of drupes, ripening stage, harvesting and carriage systems, method and duration of storage, and processing technology. The major factors affecting edible oil quality are temperature, moisture, sunlight, soil fertility, and nutrients. The content of trace elements and their chemical forms can be naturally present in vegetable oils that were absorbed by the vegetable mainly from the soil where it was grown. A possibility of trace elements entry into edible oils other than the technological one is the environmental exposure to a large variety of elements. They can be also incorporated during the extraction and refining process to which the oil is extracted. In Ethiopia a study on the level of metals in edible oil a total oil sample size (n=4) two imported (Viking and Avena) and two processed in Ethiopia (Selam and Nur) oil samples were used. The report from the result showed that levels of Cu in Viking and Avena oils that were 0.62 mg/L and 0.28 mg/L, respectively, and in Selam and Nur oils 0.86mg/L and 0.42 mg/L, respectively, and the levels of Zn in Viking and Avena oils that were 1.58 mg/L and 1.27/L mg, respectively, and in Selam and Nur oils 1.19 mg /Land 1.47mg/L respectively [49].

According to the above research report the physico-chemical properties and level of essential metal revealed that four edible oils were acceptable to human consumption. Metals arrive in the plant via deposition as well as bioaccumulation from the soil via the natural metal sources and environmental pollution. In addition to these facts, the agricultural habits of the farmers play an important role in the metal contents of their products such as the application of fertilizers or metal containing plant protection agents. In this study similar with the study conducted in other study report on the level of zinc and copper that are potentially present in oil samples caused by environmental contamination [46]. The result of physico-chemical properties shows that acid value, saponification value, iodine value, peroxide value and the metal levels were in the acceptable range compared to WHO/FAO report.

In Ethiopia limited study done on shelf life prediction of edible oil one study report using three edible oil sample (n=3) the qualities of edible cotton, peanut and soybean seed oils, and predict their shelf stability using the accelerated shelf-life testing method. According to the study report the predominant fatty acid in edible soybean and cottonseed oils were linoleic acid 42.8% and 41.6%, respectively. While oleic acid (46.3%) was the major fatty acid in edible peanut oil. Based on this, the shelf-life of the domestic edible oils determined at room temperature and amounts 36.9, 42.1 and 37.8 weeks for soybean, peanut and cottonseed oils, respectively [3].

Compared to soybean and cottonseed oil, peanut oil has longer shelf-life. The shelf-life of properly refined edible oils is typically 12–18 months at ambient temperature [31]. As compared to the literature, the shelf-life of edible oils determined in this research was lower. Studies using soybean oil indicate that peroxide levels ranging from 1.0 to 5.0 meq/kg signify low oxidation; 5.0–10.0 meq/kg signify moderate oxidation; and 10.0meq/kg and above signify high levels of oxidation [36].

Industrial processing, especially catalytic hydrogenation of vegetable oils, affects their fatty acid composition [13]. Higher hydrogenation of oil is directly proportional to higher saturation, solidification and presence of Trans fatty acid. Highly saturated fatty acid diets have been found to increase the level of cholesterol [21]. Several studies have shown that palm oil has a hypercholesterolemic effect because of its high saturation to 50% palmitic acid (C16:0). This high source of saturated fats in the human diet thought to have detrimental effect on human health, particularly when compared with Polyunsaturated Fatty Acids (PUFAs) [5].

From other study in Ethiopia report a sample size (n=16) Sixteen different types of solid and liquid edible oils from main shops and supermarkets in Addis Ababa examined [6]. According to the report the solid oils have higher iodine value, saturated, monounsaturated, Poly unsaturated fatty acids, Cis, Trans, Omega-6 fats as compared with the liquid. Palm oils have more Trans, saturated, monounsaturated and lower omega-6 and cis fats [14]. In this study Report , there was 47% SFAs and 11.57g PUFAs from100g for palm oil.several studies showed the correlations between high intakes of industrially produced TFAs and increased risk of CHD [56]. Imported palm oils contain surplus amount of saturated fatty acid; and according to the consumption, it is usually surpass the WHO daily recommendation amount [37].

4.2 Microbial Safety and Quality of Edible Oil

A limited work done in Ethiopia on aflatoxin contamination of edible oil [38]. A study done a sample size of (n=48) samples from this the level of contamination for Ethiopian oils (n=21) ranged between (0.07-145.59 μg/kg) for total aflatoxins [15]. From 27 edible oil samples from Guangzhou, China, the total concentration of aflatoxins (AFB1 + AFB2 + AFG1 + AFG2) ranged between (0.03 - 2.23 μg/kg) [10]. Aflatoxin (AF) ingestion through contaminated foodstuffs causes 250 000 deaths every year from hepatocellular carcinoma in China and sub-Saharan Africa. Previous studies on oil seeds, byproducts, and peanuts also support the higher rate of aflatoxins in Ethiopia [17]. The noug cake, which is the byproduct of the Niger seed oil extraction process, was cited as the primary source of aflatoxin detection in samples taken from the commercial milk supply in Addis Ababa, Ethiopia [23]. Another study was conducted in eastern Ethiopia with 120 groundnut samples. From these, 93 (77.5%) tested positive for the total aflatoxin levels in the positive samples, varying between 15 and 11 900 μg/kg. These results reveal that there is heavy contamination in oil seeds and groundnuts in Ethiopia [7].

According to the report done by [24] A total of sample size (n=125) One hundred twenty five edible oil samples examined among which the report of the result 62(48%) samples were containing a varying number of bacteria and Moulds. The study report showed that the aerobic plate count detected in 46(35.6%), moulds 32(24.8%), Yeasts 4(3.1%), total coliforms 6(4.5%) samples [18]. Fecal coliforms, E.coli and S.aureus found only in one sample. None of the examined edible oil samples contain salmonella and shigella organisms [19].

The average microbial load is not higher than 105cfu/ml for Aerobic mesophillic bacteria and 104cfu/ml for moulds. The findings of this study shows that the mould and yeast results are found to be in a mean count of 4.1x104 ± 4.48x102cfu/ml and 3.2x104±2.62x102cfu/ml respectively. In this study mould and yeast count were nearly similar with the study conducted in Nigeria by [39] and Gonder town, Ethiopia by [49] with mean count of 4.43x103±1.25x104cfu/ml. In a similar study conducted in Nigeria the presence of high load of Yeasts and Mould in edible oil causes deterioration by secreting extra cellular lipases enzyme [28]. This enzyme breaks down ester bonds in lipid molecules and liberates diglycerides, monoglycerides, and glycerols, Free fatty acids and results in increment of free fatty acid values of edible oil leading to deterioration [35]. Food borne disease is critical public health problem (Odoh et al.,2017). Microorganisms are known to cause chemical changes in edible oil that lead to deterioration in the quality of the oil [39]. The lipolytic activity of fungi on the triglycerides of oils and fats used in baking formulations may cause rancidity, acidity, bitterness, soapiness and other off flavors [44].

[35] reported A total of sample size (n=50) samples collected from the markets and the microbial load and physico-chemical characteristics reported [47]. The mean Acid Value (AV) ranged from 5.90±1.29 to 15.67±1.41 mg KOH/mL. while the mean Free Fatty Acid (FFA) Peroxide Value (PV) and Iodine Value (IV) and pH value ranged from 3.25 to 8.00%, 2.00 to 26.90 meq O2/mL, 180.60 to 468.72 g I2/100 mL and 6.32 to 6.80 Respectively [42]. All the samples had highest value as compared to WHO standard. The result of this study is close to the finding of [4].

The aerobic mesophilic count of the locally produced oil ranged from 4.54±5.82 to 12.13±1.98× 103 cfu/mL, the yeast and mold count of the locally produced oil ranged from 7.74±9.64 to 16.93±2.68 103 cfu/mL [50]. The microbial isolates were Staphylococcus aureus, Pseudomonas aerugenosa, Kelebsiella pneumonie,Shigella sonnei, Penicillium chrisoginum, Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus,Aspergillus versicolor, Fusarium oxisporium, Candida albicans and Mucor spp. The microorganisms isolated in this study are closely similar to species reported by other studies in Nigeria, [39] and [27]. But in this study in addition to Staphylococcus aureus, Penicillium chrisoginum, Aspergillusflavus, A. fumigatus, Candida albicans and Mucorspp [52]. Pseudomonas aerogenosa, Aspergillus niger, A. versicolor and Fusarium oxisporium also isolated and reported.

5. Edible Oil Quality and Safety Management Systems

Industries in Ethiopia, the food processing industries are suffering from quality related problems [53]. These problems include poor performance of products in the export market, low quality and insufficient raw material supply, low product confidence due to lack of quality assurance systems and increased pressure from high quality and competitive products in the local market. The solution is to implement a properly developed Quality Management System (QMS) in the industry.

To establish and improve standards of cooking oil, there must be apply the Edible oil quality and safety management system. Such as HACCP as a preventive safety control system of edible oil. From every aspect of the cultivation of raw materials, procurement, production, storage, transportation, quality control can be carried out, strictly controlling quality security of edible oil, to eliminate the edible oil quality problems from the source of edible oil, thereby producing safe, healthy edible oil. Second; establish the national standards certification of edible oil, carry out unified certification bodies of edible oil. Thereby promote edible oil quality management system and connect it with international standards. Third; implement the market access system on the edible oil market. Fourth Cooking oil inspection and detection inspect the production process quality control; inspect environment and sanitation conditions; inspect product quality control [33].

6. Conclusions and Future Perspectives

The reviewed study reported all the edible samples taken from local (from market Addis Ababa, Bahir Dar, Gonder, Ambo and in abroad the country) and imported [57]. According to different research report all Edible samples have quality and safety problems such as physico chemical and microbial safety. Comparing to the international standards (WHO, FAO, CODEX210-1999, CODEX STAN210-1999) except one research report [48]. All had physico chemical and microbial safety problems for all site collected samples. This demonstrates the need for investment into food safety development in Ethiopia (investment in infrastructure and intervention studies) to improve domestic public health and enhance opportunities for Ethiopian participation in international trade [55].

Overall, the assessment of the effectiveness of educational interventions targeting the reduction of contamination in the Edible oil supply chain through improvement of knowledge and implementation of good hygiene and production practices is needed to inform larger coordinated efforts focused on improvement of edible oil safety in Ethiopia. Lastly, local millers should take care of on edible oil processing special the government should implement the quality control system in the country as well as motivating investors to participate and build refined technology for edible oil production in Ethiopia.

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