J. Sci. Univ. Kelaniya 16 (2) (2023): 63-76 https://doi.org/10.4038/josuk.v16i2.8081

Exploring the quality and safety issues in the coconut oil processing industry in Sri Lanka: A Review

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Received: 29.05.2023 Revised: 28.07.2023 Accepted: 14.09.2023 Online: 15.12.2023

Abstract Coconut oil is a significant dietary component in Sri Lanka and serves as the primary source of fat for Sri Lankans, primarily used for culinary purposes. This review focuses on the quality and safety concerns within the coconut oil processing industry of Sri Lanka. The study collected data through interviews with industry personnel, conducted field visits to both small-scale and large-scale operations, and analyzed existing research. Several factors impact the quality and safety of coconut oil products. Key issues include the increase in free fatty acid content, the production of aflatoxin in copra, phthalate contamination from packaging, and the contamination of coconut oil with polyaromatic hydrocarbons (PAH). These quality and safety concerns result from cross-contamination with metals and other chemicals during equipment use, a shortage of trained personnel, insufficient laboratory testing of oil quality parameters before market distribution, and inadequate surveillance of small and medium-sized oil mills by regulatory bodies. Additionally, the local market faces high levels of adulteration, where coconut oil is mixed with lower-quality oils, stored improperly, or is of overall poor quality. Issues related to coconut cultivation include a decline in yields due to inefficient land usage, reduced productivity, climate change impacts, pest infestations, diseases, and increased production costs. The adulteration problem arises from the supply-demand gap for coconut oil in Sri Lanka and the high cost of producing one litre of good-quality coconut oil. The Sri Lankan government and the Sri Lanka Standards Institution have introduced a product standard for coconut oil production, outlining key parameters for the final product. Nevertheless, the absence of a comprehensive process standard affects quality control throughout production. Small and medium-scale producers lack awareness of SLSI standards, leading to non-compliance, along with an absence of regular quality and safety checks. Consequently, stringent enforcement is necessary to address these challenges. While improvements have been made, unresolved issues remain; therefore, a quality assurance system for the coconut oil processing industry is an urgent requirement, especially for small and medium-scale oil production facilities, which are key suppliers to the local market.

Keywords: Coconut oil, copra, polyaromatic hydrocarbons, aflatoxins, phthalate

Introduction

Coconut (*Cocos nucifera* L.) is one of the foremost plantation crops in Sri Lanka, having significant cultural, economic, and culinary value. The coconut market comprises of diverse products, including fresh coconut, kernel products such as coconut oil, desiccated coconut, coconut milk, and coconut cream, and various by-products such as coconut water, coconut fiber, coconut shell charcoal, and activated carbon (Abeysekara et al., 2020). Over the past decade, the coconut industry in Sri Lanka has displayed consistent growth in its export performance, Sri Lanka plays a significant role in the global coconut oil industry, meeting 1.33% of the global demand valued at USD 62.7 Million by 2022. In 2018 and 2019, the export of coconut oil amounted to 4,606 and 4,056 metric tons, respectively, earning 3,019.96 and 1,903.45 million rupees, respectively (Coconut Development Authority, 2020; EDB, 2023). Key importers include the USA, Australia, Germany, Saudi Arabia, the UK, and the Netherlands. In 2019, coconut oil held a substantial market share, representing roughly half of the global coconut products market due to its widespread use in food, beverages, and personal care products. Additionally, the rising global demand for Virgin Coconut Oil (VCO) as a functional food with health benefits has prompted Sri Lankan coconut oil manufacturers to produce VCO to cater to this growing market (EDB, 2023; Aiome et al., 2022). Kernel products emerged as the primary contributor to the total export value, accounting for 52% with a value of USD 434.57 million in 2021 (Central Bank Annual Report, 2021).

Effective implementation of quality and safety measures is critical for ensuring the sustainability and competitiveness of Sri Lanka's coconut oil industry in the global market. Therefore, ongoing research and development efforts should be directed towards identifying and addressing the quality and safety issues that are specific to Sri Lanka's coconut oil industry, with the aim of improving the quality and safety of coconut oil products and enhancing the industry's reputation and profitability.

Quality and safety issues regarding raw materials

Raw materials play a crucial role in the processing of any commodity, and the quality and safety of the raw materials can significantly impact the final product's quality (Th et al., 2018). Specifically, the raw materials can be in the form of dried copra for the dry process, fresh coconut kernel for the wet process, and testa for pairing oil (Jia et al., 2023; Josephrajkumar et al., 2019). Sun drying is a traditional and low-cost method used in copra processing in Sri Lanka. However, it is highly dependent on the availability of sunlight, and sudden increases in humidity can cause copra to reabsorb moisture from the environment (Herath et al., 2022; Stein et al., 2015). Sun drying is typically done in open and unshaded areas, where copra can meet dust, sand, and animal faecal material, potentially contaminating the copra with pathogenic microorganisms. Oxidation of oil can also occur during this period if sun drying is not conducted under hygienic and controlled conditions (Karunarathna et al., 2019; Wanniarachchi et al., 2023).

Direct heat drying, such as using a copra kiln, is another common method of copra drying in Sri Lanka. Coconut husks or shells are commonly used as fuel for the kiln, and the split kernels are kept on a platform above the fuel that is set on fire. The heat generated comes into direct contact with the kernels, but the smoke produced during combustion can lead to the production of low-quality copra with a blackish colour (Mendis 2017; Herath et al., 2022). Furthermore, the smoke can contaminate the copra with polyaromatic hydrocarbons (PAH) and dioxin, which can result in residues in the coconut oil produced, leading to rejections of Sri Lankan coconut oil in the international market. Additionally, incomplete combustion of coconut husks can lead to the generation of PAHs. Uneven drying can also occur if the kiln is not heated prior to loading the split kernels, leading to cold air pockets and delaying the drying of the kernel (Credo & Valmoria, 2019; Herath et al., 2022).

Storage of copra in inadequately ventilated and damp conditions, especially in small-scale operations, can lead to the reabsorption of moisture from the environment, activating mold and bacteria on the copra surface, resulting in the growth of microorganisms, increased free fatty acid content, and aflatoxin production (Sultan et al., 2019; Tuhumuri et al., 2021). Transporting copra for milling presents challenges due to long travel times and uncontrolled conditions, leading to increased contamination (Udana & Amarasinghe, 2016).

Further, the mixing of superior and ordinary-grade copra during white coconut oil extraction increases the moisture and FFA content of the resulting oil, reducing its shelf life and quality (Herath et al., 2022). Furthermore, rejected copra with bacterial and fungal growth, which can contain harmful substances like aflatoxins, is also used for oil production, further compromising the quality of the extracted oil. High moisture content in such copra promotes rancidity and FFA production in the resulting oil (Deepa et al., 2015; Wanniarachchi et al., 2023).

Scientifically, the primary concern with copra is its contamination with aflatoxins due to inadequate drying methods, low-quality nuts, and improper storage (De Asis et al., 2020; Farias et al., 2019; Guchi, 2015). Sun-dried copra is especially prone to contamination, and aflatoxin B2 and G1 have been detected in local coconut oil (Herath et al., 2022; Lakshman et al., 2022). Wanniarachchi, et al., 2023; Lakshman et al., 2022 indicate that 38% of local coconut oils in Sri Lanka exceed the aflatoxin limits set by the Sri Lanka Standards Institute, including branded coconut oils. They suggest that the source of contamination is copra. During copra processing, exposure to smoke could reduce the aflatoxin levels. However, this could increase the risk of potential contamination with polyaromatic hydrocarbons, introducing a new safety issue.

Contamination of coconut oils with Polyaromatic Hydrocarbons (PAHs), a group of over 200 different contaminants, poses a significant industry problem as these lipophilic compounds are readily absorbed by coconut oil (De Silva et al., 2018; Ji et al., 2022). PAH is formed during the incomplete combustion of organic material, and the main source in the coconut oil industry is the smoke produced during copra drying (Sampaio et al., 2021). PAH contamination can also occur through air transfer, if the kilns are placed within the mill's land or if the mills and refining plants are in highly polluted areas. Despite this, PAH contamination in coconut oil remains an unsolved issue in Sri Lanka (Herath et al., 2022).

Testa, the by-product of desiccated coconut and virgin coconut oil mills, is utilized to extract high-quality pairing oil; nevertheless, challenges arise in its production when appropriate methods and hygienic conditions are not implemented (Srivastava et al., 2016). In the case of many virgin coconut oil producers, which is the main income, the production of pairing oil, which serves as an additional source of income, is often paid less attention and improper processing of testa results in the production of low-quality pairing oil (Zainol et al., 2023).

The high free fatty acid and moisture content of testa make it susceptible to microbial attacks and rancidity. Therefore, it is important to send testa for oil extraction immediately after separation from the kernel (Ramesh et al., 2021). However, this is often not the case, as producers store testa until they have collected the desired amount, leading to the growth of microorganisms due to the high lipid and moisture content. Proper handling and processing of testa are necessary to ensure the quality and safety of the pairing oil extracted from it (Marasinghe et al., 2019).

Issues related to the processing methods

Inadequate fulfilment of specific processing conditions for different varieties of coconut oil affects the end product's quality and safety, with small and medium-scale processing plants often neglecting the critical step of using separation methods to remove impurities from copra, such as sand, soil, ashes, broken shells, and wood particles which can affect the safety and quality of the end product (Herath et al., 2022; Lira et al., 2017; Marasinghe et al., 2019; Mohammed et al., 2021; Ng et al., 2021).

The filtration process of coconut oil, which is utilized in both white and crude coconut oil production, presents several challenges. Plate-type filters are typically used in the filtration process, with the cotton cloth being the filter medium. As coconut oil is highly corrosive, the cotton cloth quickly deteriorates, resulting in the addition of small cotton strands to the oil (Beristaín-Bauza et al., 2018; Dharmaratne et al., 2016; Rohman et al., 2021). This presents a major problem in white coconut oil processing, as it is not subjected to any further purification steps after filtration. The accumulated cotton strands or cloth particles can remain in the oil, diminishing its clarity and negatively affecting its quality (Dharmaratne et al., 2017; Oseni et al., 2017)

Controlling the processing temperature is challenging, especially in small and medium-scale expelling processes, and it is particularly difficult to maintain the pressure head below 60°C during the extraction of Virgin Coconut Oil from desiccated coconut (Agarwal & Bosco, 2017; Cañeda et al., 2019). Large-scale companies use water-jacketed expellers to remove the heat, but smaller operations have difficulty controlling temperature as they cannot afford expensive equipment. Discoloration of coconut oil due to heat is a common issue among small-scale coconut oil millers, which is difficult to avoid (Ghani et al., 2018).

Issues related to processing equipment

The coconut oil milling process involves the use of a limited number of processing equipment, especially in medium and small-scale plants (Herath et al., 2020). Despite this, there are several issues that can significantly affect the quality of the coconut oil produced. One such issue is the potential for cross-contamination with metals and other chemicals from the equipment. Therefore, it is recommended to use stainless steel for expellers and filters to withstand the acidity of the oil (Hasan et al., 2015). However, many medium and small-scale manufacturers do not follow this recommendation, leading to contamination of the oil with metal

particles, especially ferrous ions, which can have negative health implications (Syukur et al., 2022).
Poor sanitation, cleaning, and maintenance practices of equipment in coconut oil production contribute to quality issues, as the high nutritional content of coconut oil and raw materials makes equipment surfaces highly susceptible to microbial growth, emphasizing the need for regular cleaning and maintenance. However, inadequate attention to this aspect by many millers leads to contamination of the oil with microorganisms and dust particles (Gamage et al., 2018; Jose et al., 2017; Lee at al., 2015; Mohan et al., 2015). Small-scale producers using the same expeller for different oil types without proper cleaning between processes can result in cross-contamination and oil oxidation, while the use of non-food grade cleaning agents that are inadequately removed can further contribute to contamination (Thanuja, 2015). The lubricants and chemicals used for repairing the equipment should never contact the food contact surface, as they can contaminate the oil. Overall, education on these issues is crucial for millers to improve the quality of coconut oil production (Gunawan et al., 2018; Liu et al., 2019).

Issues related to the employees

Employee-related issues have a significant impact on the quality and safety of food products, including coconut oil, with the behaviour and attitudes of employees playing a crucial role. However, in coconut oil mills, the presence of trained staff varies depending on the scale of production, with small-scale mills lacking knowledge regarding quality and safety aspects, relying on experience-based knowledge and advice (Herath et al., 2022). Limited opportunities for acquiring expert knowledge contribute to employee-related problems in small-scale mills, while medium-scale mills face challenges in maintaining quality and adhering to standards due to financial constraints despite having both trained and untrained staff (Gordon, 2017). The recruitment of non-executive workers in both large and medium-scale mills often occurs without prior investigation, and their health conditions are not checked, which is a crucial aspect to consider. Daily-wage workers may not be fully focused on their assigned tasks within the mill, which can lead to poor hygienic practices and safety precautions (Bhuvaneswari, 2015).

Challenges in Ensuring Quality and Safety of Coconut Oil through Laboratory Testing

There are several challenges associated with laboratory testing that affect the reliability of test results. One major challenge is the insufficient testing of coconut oil quality parameters before releasing the product to the market (Odoom & Edusei, 2015). Small and medium-scale coconut oil mills in Sri Lanka typically lack laboratory facilities, while larger-scale mills possess these resources. A study conducted by the Coconut Research Institute in Sri Lanka revealed that 36% of samples from retail shops and 20% of samples from wholesale shops exceeded the Sri Lanka Standards (SLS) limits for free fatty acids of 0.8% as lauric acid. Additionally, high moisture content was found in 30% of samples from wholesale shops and 33% from retail shops (Kaushalya et al., 2018; Pathirana et al., 2021). This indicates that proper quality parameter testing is not being conducted at the processing mills themselves. A significant deficit in laboratory testing for aflatoxin, Polyaromatic hydrocarbons, and phthalate exists in the Sri Lankan coconut industry, with larger-scale mills conducting tests mainly upon buyer's request, while small and medium-scale millers lack the financial capacity to establish their own laboratories or afford external testing services, resulting in reliance on industry experience rather than comprehensive testing to maintain quality (Dharmakantha, 2015).

Issues related to packaging and labelling of coconut oil

World Health Organization Report 2020 noted that the packaging of coconut oil is not regulated in Sri Lanka, and the responsibility falls upon the purchaser and supplier to agree upon a suitable, well-closed container. This lack of regulation increases the risk of contaminants, such as phthalates, which can act as hormones and interfere with the body's natural endocrine responses, affecting the body's physiological control mechanism, anti-androgenic and damaging the DNA in sperms (Giuliani et al., 2020; Stelmach et al., 2015; Mariana et al., 2016). While Sri Lanka lacks specific regulations on migration limits of phthalates, Sri Lankan exporters have proactively adopted measures to prevent contamination with phthalates in coconut oil through adherence to stringent packaging regulations in foreign markets, guided by the migration limits set by the European Food Safety Authority based on epidemiological evidence of adverse health effects (Dharmakantha, 2015). However, no government-intervened analysis has been done to identify the presence of phthalates in coconut oil within the local market. Therefore, it is crucial to introduce regulations and carry out analyses to ensure the safety and quality of coconut oil in Sri Lanka.

Issues related to the marketing of coconut oil

In Sri Lanka, the quality and safety of coconut oil depend largely on the marketing stage rather than the processing stage. Adulterations and food safety breaches are common during the marketing of coconut oil. About 70% of the coconuts produced in Sri Lanka are for domestic consumption, making coconut oil the main edible oil for Sri Lankans. Coconut oil is deeply embedded in Sri Lankan culture, and despite the availability of alternative oil types, 91% of the population still relies on coconut oil as their primary source of fat (Gunawardana 2018; Phanga et al., 2022; Sandupama et al., 2022). Therefore, the potential for adulteration and food fraud incidents is high in the local market. The issues identified in the local market include the adulteration of coconut oil with low-quality oils, used coconut oils, and palm oil for economic gain and higher profit. In the virgin coconut oil industry, instances of food fraud manifest through the blending of virgin coconut oil with RBD (refine, bleach, deodorize) coconut oil and palm olein, aiming to attain heightened profits (Weerasinghe & Malkanthi, 2022).

The adulteration of coconut oil, predominantly occurring during the release of oil to the markets rather than within mills, continues to be a significant challenge in the Sri Lankan coconut oil industry, with palm olein, palm kernel oil, corn oil, soybean oil, used coconut oil, and non-food grade coconut oil being commonly used for adulteration purposes (Jayathunga et al., 2020; Wara 2019). Palm kernel oil has almost the same characteristics as coconut oil, making it easy to mix and difficult to differentiate (Herath et al., 2020).

The reason for adulteration is the gap between the supply and demand for coconut oil in Sri Lanka, not in terms of quantity but prices (Weerasinghe & Malkanthi, 2022). The production price of one litre of good quality regular coconut oil falls between Rs.500 - 600.00 in the year 2023, whereas the market price is much higher. Adulteration is, therefore, a way for vendors to maximize their profits.

Quality and safety issues related to the consumption of coconut oil in sri lanka

Coconut oil is a significant dietary component in Sri Lanka and is the primary source of fat for many Sri Lankans (Mulyadi et al., 2019; Sankararaman et al., 2018). However, concerns regarding the quality and safety of coconut oil extend to consumption, particularly in domestic and food service industry settings, where the common practice of reusing coconut oil for frying can result in the formation of harmful compounds such as free radicals, increased free fatty acid content, and the generation of trans-fatty acids due to high temperatures and exposure to oxygen during frying (Bhardwaj et al., 2016; Wallace 2019). These compounds can be absorbed by the food being fried and can pose health risks to consumers and it is suitable for reuse only up to two times (Boateng et al., 2016).

In Sri Lanka, coconut oil is frequently reused in the food service industry, especially in small restaurants and street vendors. The oil used in star-class hotels is often sold to small restaurants for reuse (Arachchige et al., 2021). The consumption of free fatty acids, trans-fats, and molds that can produce aflatoxin and other harmful metabolites can pose health risks to consumers. In households, coconut oil is mostly reused due to economic barriers, but it is not as problematic as in the food industry (Karunarathna et al., 2019).

Issue related to the regulations and standards for coconut oil in sri lanka.

Food standards and regulations play a pivotal role in safeguarding food quality and ensuring food safety within any nation. Unfortunately, Sri Lanka exhibits significant shortcomings in its food regulations, leading certain food processors to exploit these gaps in an attempt to introduce substandard products to the market. Consequently, it is imperative to establish robust rules and regulatory frameworks in Sri Lanka, specifically tailored to guarantee the quality and safety of coconut oil and coconut-based products.

Furthermore, stringent enforcement measures by regulatory authorities are essential to ensure full compliance with these standards. While there have been improvements in coconut oil standards, issues remain that require attention, such as the need for a process standard to ensure product quality and safety throughout the production process (Herath et al., 2022).

The lack of packaging regulations in coconut oil production has led to contamination issues, such as phthalate contamination, due to the absence of limits in Sri Lankan standards and regulations, resulting in the need to import compliant packaging materials. Furthermore, the absence of mandatory limits for aflatoxin and Poly-aromatic hydrocarbons, unless included in the Food Act, combined with the burdensome process of obtaining SLS certification, discourages compliance among small, medium, and middle-scale millers. This emphasizes the necessity for mandated standards and regulatory inclusion to promote widespread compliance (Wanniarachchi et al., 2023).

Parameter		SLSI Standards	EU Standards
Aflatoxin level	Aflatoxin B1	5.0 µg/ kg max	2.0 µg/ kg max
	Total aflatoxin	10.0 µg/ kg max	4.0 µg/ kg max
Polycyclic Aromatic Hydrocarbon (PAH)	Benzo(a)pyrene	2.0 µg/ kg max	2.0 µg/ kg max
	Total PAH Benzo(a)pyrene Benz(a)anthracene Benzo(b) fluoranthene Chrysene	20.0 µg/ kg max	20.0 µg/ kg max
Heavy metals	Arsenic Lead Cadmiun	0.1 mg/ kg, max 0.1 mg/ kg, max 0.1 mg/ kg, max	0.1 mg/ kg, max 0.1 mg/ kg, max 0.1 mg/ kg, max
Sum of 3-monochloropropanediol (3-MCPD) and 3-MCPD fatty acid esters, expressed as 3-MCPD		Not established	1250 µg/kg

Table 1: Comparison between critical parameters of SLSI and EU standards of Coconut oil intended for direct human consumption or use as an ingredient in food
Sources: SLS 32: 2017 Amendment No. 1 and Commission Regulation (EU) 2023/915

Currently, several standard-setting bodies, such as the European Union (EU), have established guidelines governing maximum permissible levels for aflatoxins in human food and animal feed (Wu & Guclu, 2012), to ensure consumer safety and to promote international trade. Sri Lanka Standards Institute (SLSI) has taken measures to incorporate maximum permissible levels for aflatoxins in their certification scheme for edible oils. However, it is not mandatory for all edible oil producers to comply with this standard as participation in SLS certification is completely voluntary (Karunarathna et al., 2019).

The table 1, provides a comparison between the standards set by the (SLSI) and the (EU) for coconut oil across various parameters related to food safety.

Since aflatoxins are genotoxic carcinogens, it is appropriate to limit the total aflatoxin content of food (sum of aflatoxins B1, B2, G1 and G2) as well as the aflatoxin B1 content alone (Benkerroum, 2020; Tang et al., 2015). Sri Lanka's SLSI standard allows for a maximum concentration of 5.0 µg/kg of Aflatoxin B1 in coconut oil, while the EU sets a more stringent limit of only 2.0 µg/kg. This signifies that the EU places a stronger emphasis on minimizing Aflatoxin B1 contamination in products intended for human and animal consumption. Sri Lanka's SLSI standard permits a maximum total aflatoxin concentration of 10.0 µg/kg, while the EU sets a more stringent limit of 4.0 µg/kg. This indicates that the EU places stricter controls on the cumulative aflatoxin contamination in food and feed products, emphasizing a higher level of food safety and quality

In terms of Polycyclic Aromatic Hydrocarbons (PAHs), both organizations have set the same limit for Benzo(a) pyrene. Similarly, for the total PAH content, they share an identical limit as well. In the case of heavy metals like arsenic, lead, and cadmium, both SLSI and EU have established identical maximum limits, ensuring consistent safety in this regard.

MCPD is a chemical food contaminant, detected first as a by-product of hydrolyzed vegetable protein by action of hydrochloric acid on residual lipid (Dubois et al., 2012). 3-MCPD is known to have an in vivo carcinogenic and in vitro genotoxic activity (Hamlet et al., 2002) while palm oil, corn oil and coconut oil possess the highest potential for 3-MCPD formation (Matthäus et al., 2011). Notably, for the presence of a Sum of 3-monochloropropanediol (3-MCPD) and 3-MCPD fatty acid esters, expressed as 3-MCPD, the EU sets a specific limit of 1250 µg/kg, while the SLSI does not provide a clear standard.

In summary, the European Union's standards for coconut oil tend to be more comprehensive and stringent in various aspects, including aflatoxin and 3-MCPD levels compared to the standards set by the Sri Lanka Standards Institution.

Table 2: Comparison between SLSI and Codex standards of chemical and physical characteristics of coconut oils

Parameters		SLSI Standard	Codex Standard
Fatty acid composition (as methyl esters), percentage by mas	C6:0	ND - 0.7	ND - 0.7
	C8:0	4.6 - 10.0	4.6 - 10.0
	C10:0	5.0 - 8.0	5.0 - 8.0
	C12:0	45.1 - 53.2	45.1 - 53.2
	C14:0	16.8 - 21.0	16.8 - 21.0
	C16:0	7.5 - 10.2	7.5 - 10.2
	C18:0	2.0 - 4.0	2.0 - 4.0
	C18:1	4.5 - 10.0	5.0 - 10.0
	C18:2	1.0 - 2.5	1.0 - 2.5
	C18:3	ND - 0.2	ND - 0.2
Antioxidants	Propyl Gallate	100 mg/kg max	100 mg/kg max
	Butylated Hydroxyanisole (BHA)	200 mg/kg max	175 mg/kg max
		120 mg/kg max	120 mg/kg max
Iodine value		7.5 - 11.0	6.3 - 10.6
Insoluble impurities per cent by mass, max		0.05	0.05
Saponification value (mg KOH/g oil)		248 - 265	248 - 265

(Sources: SLS 32: 2017 Amendment No. 1 and Codex Alimentarius Commission. (1999))
ND – Not detectable (defined as ≤ 0.05)

Table 2 presents a comparison between the standards set by the Sri Lanka Standards Institution (SLSI) and the Codex Alimentarius Commission for various chemical and physical characteristics of coconut oils. Notably, both SLSI and Codex standards align closely in terms of fatty acid composition, specifying similar ranges for various fatty acids. Likewise, the regulations for antioxidants, such as Propyl Gallate, (BHA), and (TBHQ), show harmonization between the two standards, while BHA shows slight differences in allowable limits (Lucaccioni et al., 2019).

Among the key quality parameters, the saponification value, iodine value, and the presence of insoluble impurities play a crucial role in assessing the chemical composition of the oil and ultimately determining its overall quality (Odoom & Edusei, 2015). For the saponification value and the insoluble impurities, both organizations have set the same limits. According to the Codex Alimentarius (1999) the iodine values range between 6.3-10.6 while in SLSI it is 7.5 to 11. The iodine value or iodine number is the generally accepted parameter expressing the degree of unsaturation, the number of carbon-carbon double bonds in fats or oils. Therefore, the higher the iodine value the greater the degree of unsaturation (Chebet *et al.*,2016).

Conclusions

Ensuring consistent quality and safety in the coconut oil industry requires addressing various factors such as raw materials, processing conditions, packaging, storage, equipment, employees, and laboratory testing. Implementing rigorous quality control measures, standardized procedures, employee training, and regular equipment maintenance are essential. Additionally, government intervention and close surveillance can contribute to the overall improvement of the coconut oil processing industry in Sri Lanka.

Acknowledgement

The authors gratefully acknowledge the Coconut Development Authority, Sri Lanka Standard Institute, and the Ministry of Health, Sri Lanka for their invaluable insights and support, which greatly contributed to the development of this manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

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