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Voluntary Maize Flour Fortification in Tanzania: Adequacy of Small-Scale Processors' Implementation of the Quality Assurance and Quality Control Programmes

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Abstract: This study systematically evaluated the implementation of fortification practices, including quality assurance and quality control, among small-scale processors to ensure regulatory compliance. A descriptive cross-sectional survey was conducted in Ubungo district (Dar es Salaam) and Morogoro municipality, Tanzania, involving 38 processors. Data collection relied on observational checklists and IBM SPSS ® version 20 for analysis. Descriptive statistics revealed critical insights. Cleanliness and sanitation standards were met in only 36.8% of warehouses and 42.1% of production areas, underscoring hygiene deficiencies. Alarmingly, 26.3% of micronutrient premixes were inappropriately stored near heat-generating milling machines. Written procedures for quality assurance and quality control were virtually absent, with just 2.6% of processors having such documentation. A mere 13.2% of processors conducted quality checks on fortified maize flour to confirm micronutrient presence. This study identified pervasive shortcomings in quality control and assurance practices among small-scale processors. Hindrances included inadequate training in fortification standards, limited processing capacity, and constrained access to quality control facilities. Strengthening these practices is imperative to ensure the consistent delivery of safe, high-quality fortified maize flour, essential for the nutritional well-being of target populations. This action holds significant public health and food safety implications.

Keywords: Fortification, Quality Assurance, Quality Control, Practices, Small-Scale Processors

1. Introduction

Flour fortification is the practice of deliberately increasing the content of one or more essential micronutrients in flour. Fortification of wheat and maize flours with vitamins and minerals is considered a cost–effective strategy to address micronutrient malnutrition and nutrition-associated health outcomes, such as prevention of neural tube defects [2, 8]. Fortification programmes must be monitored to confirm that they are working effectively, thereby ensuring the population is receiving a nutritious and safe fortified end-product [24]. Implementation of fortification programme requires monitoring programme which involves quality control (QC) and quality assurance (QA) at both factory and regulatory level [3]. The practice of QA/QC is necessary for the processors of fortified food to ensure processed food is of good quality and safe to consumers along with adherence to the stipulated laws and regulations. The internal quality assurance at the factory involves quality of premix, fortification process, quality control of fortified maize flour. Some of quality control includes, iron spot test to determine level of added iron in fortified flour and quality of food packaging bags, receipt, storage and delivery, feeder calibration, records keeping and laboratory analysis [24]. QA/QC as part of internal monitoring removes all anomalies that when happen in the food production chain, reduces the level of compliance to the relevant regulation/laws [16] and should be practiced by both processors and regulators. The issue of QA/QC is not priorities for many food producers especially small-scale processors which compromise health

and safety of consumers. Lack of sufficient QA/QC by food producers in most low- and middle-income countries including Africa and Asia causes persistency under fortified food in the market [16].

QA/QC is mostly practiced by large processors living behind small and medium scale processors of which about 90% of processed food especially maize flour consumed by the majority of people are produced by small scale processors [25] of which its QA/QC practices have not been evaluated. This is because, small scale processors of fortified maize flour in Tanzania operates under voluntary basis and practicing QA/QC is costly as it requires trained staff, well equipped facilities, capital and establishment and implementation of procedures for different activities performed in the food chain to attain quality. In Indonesia, WHO reported that small and medium scale salt processors account for 40% and do not have QC/QA control or any control check at factory level [24]. This raises the concern on the level of compliance of fortified food produced by small scale processors, these large proportion in the value chain in developing countries including Tanzania. QC/QA is mostly practiced by large companies who have modern equipment, well-educated and trained workers, although, not all large companies which have good quality control and quality assurance mechanism its final products comply with the stipulated standards. The self-reported quality control and quality assurance of large factories of maize flour, wheat flour, vegetable oil and sugar revealed that, 55% of samples were not fortified as per the stipulated standard [16]. Therefore, implementation of QC/QA to all level of production should be emphasized and monitored to ensure the processed food comply with the recommend standards and is safe for consumption.

Despite of the good progress made by the government of Tanzania on initiation of fortification to small scale processors, there is no specific guideline or manual for internal monitoring of fortified maize flour to small scale processor at production level. The manual for internal monitoring of fortified food in East, Central and Southern African Health Community (ECSA) members have been in place since 2007 but compliance of most of fortified food in ECSA member country were found to be low due inadequate use of existing ECSA and WHO manuals [24]. This manual demonstrates how to perform quality assurance at the mill including storage and management of the premix, use of suitable packaging and labeling, and records keeping on the use of premix in relation to flour produced. Therefore, the extent of implementation of QC/QA by small scale processors of fortified maize flour was assessed in line with WHO manual for millers, regulators, and programme managers together with respective guidelines using checklist which include cleaning and sanitation, personnel, written procedures or instructions for different activities, handling of micro-nutrient, maize flour fortification process and control of fortified maize flour.

2. Materials and Methods

2.1. Study Design

The study involved small scale processing facilities which process fortified maize flour located in Ubungo district in Dar es salaam and Morogoro municipality in Morogoro. A descriptive cross-sectional study was carried out to evaluate the extent of internal implementation of quality assurance and quality control practices by small scale processors of fortified maize flour. This design was suitable because the study intended to capture and collect particular data on maize flour fortification practices, extent of implementation of quality assurance and quality control regarding premix handling, control of fortified product, fortification process, hygiene and cleaning [5]. Data was collected from small scale processors who are under fortification programme in the current study areas.

2.2. Sampling Techniques and Procedures

A purposive sampling technique was employed. This technique was considered to be appropriate because the factory which process fortified maize flour in the study area were known and not all of them were under operation during research period due to shortage of raw materials, capitals and technical fault of machine.

2.3. Data Collection

Quality Control and Assurance

Data was collected using observation checklist by observing various processes on QA/QC undertaken by processor during fortification. This approach was appropriate as it allows the observer to explore in-depth the whole process and note relevant phenomena that revealed a clear picture of the problem under study. The checklist consists of the following main areas as described in Table 1.

Table 1. *Description of checklist used for QA/QC assessment for maize fortification processors.*

Observation Category	Description
Cleaning and sanitation	In cleaning and sanitation four areas were observed which are production area, warehouse and staff facilities and toilets and cleaning of raw materials (maize).
Personnel	Hygiene as recommended in the standard, wearing protective clothes, and training records in the performed task were assessed.
Written procedures on QA/QC	Implementation of different procedures/instruction used to ensure proper implementation of QA/QC was observed. These include; receipt and storage of raw materials, receipt and storage of premix, feeder verification and micronutrients analysis.
Control of micronutrient premix	The following procedures were careful observed in this section; premix status, availability of updated premix inventory, appropriate storage condition, first in first out (FIFO) system and handling of premix in the fortification site.
Control of flour fortification	Three items were observed in this section; availability of feeder performance records, availability of adequate premix in the feeder during fortification and availability of records of maize flour produced/premix used.

Observation Category	Description
Control fortified flour	In this area analysis of fortified maize flour using iron spot test or external laboratory, labelling of fortified maize flour according to standard, storage of fortified maize flour and use of first in first out system in dispatch were evaluated

2.4. Survey on the Challenges Faced by Small Scale Processors for Fortification Compliance

To explore challenges faced by manufacturer to attaining compliance to the recommended national standards, interviews were conducted with personnel involving in fortification at factory level. Small scale processors who were involved in maize fortification program in Morogoro and Dar es salaam were interviewed using an open-ended structured questionnaire to have an idea on what could be the challenges hindering their compliance to the recommended micronutrient fortification. They were asked what are the challenges, if any, that can hinder the processor from ensuring fortified maize flour produced comply with the recommended standards. The challenges were in the following areas;

i. Awareness and attitudes on fortification,
ii. Laboratory capacity,
iii. Capital and technical capability,
iv. Skills of workers/personal expertise and
v. Training.

2.5. Statistical Analysis

The data was analysed using Statistical Package for Social Sciences (IBM SPSS® Version 20) where simple descriptive statistic was performed to frequency and percentage that was used to summarize and describe data collected.

3. Results and Discussion

3.1. Cleaning and Sanitation

The results for extent of cleaning and sanitation are shown in Table 2. Findings reveals that cleaning and sanitation in the production area was implemented by only 42.1% of processors while only 36.8% of the warehouses were adequately cleaned. More than half of processors (60.5%) have cleaned staff facilities and toilets equipped with water and soap whereby cleaning of raw materials (maize) before processing was done by all processors.

Table 2. *Implementation of quality assurance and quality control by processors of fortified maize flour.*

Variables	Description	Implemented (%)	Not implemented (%)
Cleaning and sanitation	Production area	42.1 (16)	57.9 (22)
	Warehouse	36.8 (14)	63.2 (24)
	Staff facilities and toilets	60.5 (23)	39.5 (15)
	Raw materials (maize)	100	0
Personnel	Personal Hygiene	47.4 (18)	52.6 (20)
	Wearing protective clothing	34.2 (13)	65.8 (25)
	Trained in the task they perform[2]	92.1 (35)	7.9 (3)
Written procedures	Instruction on receipt and storage of raw materials (maize)	2.6 (1)	97.4 (37)
	Availability of instruction for receipt and storage of premix	2.6 (1)	97.4 (37)
	Instruction of control of dosage equipment	2.6 (1)	97.4 (37)
	Instruction on micronutrients analysis	2.6 (1)	97.4 (37)

[2]Check the availability of training records or training certificate; Number in bracket are the number processors (N)

Cleaning and sanitization are vital in every production process in order to ensure safety and quality of final product. Un-cleaned conditions such as raw materials, production area, warehouse, staff facilities and toilet can be a cause of final product contamination. According to Tanzania Standard on fortified milled maize (corn) products TZS328, is recommended that, all production area, equipment and the environment where food is processed, should be cleaned at regular intervals, to prevent it being a source of food contamination according [22]. In contrary, the survey in the current study observed more than half of production area (57.9%) and more than 63% of warehouses were not cleaned as some had accumulation of dust and flour around the building and above the processing equipment. This could be contributed by lack of training on importance of maintaining cleaning in processing area and lack of close monitoring by regulatory authorities. Building up of flour or bran dust in the processing area or warehouse is a major cause of cross contamination of final product as the environment will attract breeding of insect, birds and rat which contaminate grain or stored flour with hairs, feathers and excrete [12]. In addition, all processors were observed to adhere with cleaning conditions of raw materials by removing physical contaminants such as weed seeds, stalks insect remains, sand, stones and rotten maize. Cleaning of maize before processing is important as it protects the milling equipment, quality of product and health of consumers.

3.2. Personnel

Personnel compliance in the personal hygiene was only implemented by 47.4% by processors. It was found that only 34.2% of factory workers used personal protective equipment (PPE) during production while 65.8% operate without PPE as recommended in the standard. Furthermore, higher compliance (92.1%) was observed in the area of training (Table 2). In the production processes, contamination can be caused by personnel if proper hygiene is not followed.

Source of contamination can be through hair, nose, mouth and hands [10]. To implement QA/QC at the mill, the standard required personnel working in the production area to wear proper PPE [22]. In contrary, findings of this study more than 65% of workers were found not wearing proper PPE. This could be the result of lack of close monitoring of workers and inadequate training on hygiene and hygienic practice as recommended by the standard. According to UNIDO [23], personnel working in processing area should be provided with hygienic facilities including adequate clothing such as mask, hair cover and the cleanness of the same should be maintained to avoid contamination of the product [23]. The protective clothes like hair cover protect final product from hair contamination which can stuck in the throat when ingested and lead to health problem. Moreover, wearing of mask is very important as the production process of maize flour generates organic dust in the air and causes respiratory problems when inhaled [19].

3.3. Written Procedures and Instructions for Fortification Process

Written procedures or instructions of various activities done at the factory to ensure quality of fortified maize flour were also assessed and the results indicated that only 2.6% had written fortification instruction/ procedures to ensure QA/QC of fortified maize flour and surprisingly 97.4% of processors operates without written procedure (Table 2), threatening wellbeing of consumer. Proper implementation of different procedures or written instructions are necessary in the factory. Lack of procedures or instruction on how to perform a certain work can result to inconsistency and unreliable result. Documented instructions include information such as the aim of processing, detailed operation instructions (step by step), how to perform maintenance and shut down operations of the machine [1]. The current study revealed that, 97.4% of processors did not have written procedures or instruction for fortification process thus operating without written procedure. The percentage non-compliance in the current study is higher than the one reported by Mark et al. [17] in Cameroon whereby 50% of processor had instruction on storage of premix and 100% had instruction for control of dosage equipment. Having detailed documented information/procedures is very important in the processing industry as it help processors to have uniform and consistency mode of production hence improve quality. It is difficult for the millers to be consistence in adherence to QA/QC of the fortified food without written instructions on the activities carried out during fortification. According to ECSA and WHO manual [11, 24], instruction on how to receive and store raw materials, premix, feeder verification and micronutrients analysis is important for controlling quality of final products. Below is the example of written instructions supposed to be given to processor for QC/QA of premix dosed/added in accordance with production rate of fortified flour;

"When a batch process is used, the premix is added to the flour all at once. The amount of premix added must correspond to the amount of flour produced in the batch. If the flour is fortified continuously, particularly during production of large volumes, the rate of addition must be routinely checked by production supervisors. It is important to know the exact flow rate of flour per hour as this dictates the amount of premix to add over a predetermined amount of time. In mills where the flour flow rate fluctuates, the dosing equipment (feeder/dosifier) should have the capacity to respond to these changes and adjust the addition rate accordingly. To verify that feeders are adding premix at the rate entered in the mill's control panel, the premix amount discharged by the feeder in 1 minute needs to be collected and weighed. This should be repeated at least three times to calculate the average, standard deviation, and the coefficient of variation (the standard deviation divided by the average) [11, 24].

If about 97% of processor for maize flour fortification in the current study are operating falsely without such crucial manual instructions, it is obvious that the quality of such fortified maize flour is compromised and quick action is needed.

3.4. Handling of Micro-Nutrients

The results of micronutrients handling at the factory are shown in Table 3. Findings indicates that the premix used in fortification for all factories were up-to-date and handled well in the processing area. It was found that only 10.5% of the visited factory had updated premix inventory log for storing records, 73.7% of the premix were stored under appropriate conditions as specified by manufacturer and the rest 26.3% were kept direct on the floor and open in the production area. Contrary to the present study in which 26.3% of premix were found stored direct in the floor and others were kept open in the production area where heat was generated during production, Danster-Christians [7] reported much higher percentage of incompliance in handling of micro-nutrients. In his study, 63.3% of the premix were stored direct in the floor against the recommendation. According to initiatives flour millers' toolkit, premix should be properly stored away from sunlight, excessive heat [13] and on palettes made of a suitable material [11]. Also, "first-in, first-out" basis and potential water damage as to improve retention of micronutrients such as vitamin B9 should be taken into consideration when handling micronutrients [6, 9, 15]. The "first in, fist out" bases was observed by 100% in the current study. Quality of fortified maize flour is determined by quality of premix. Improper storage of premix could result in loss of some micronutrients such as vitamin B9 which will result to noncompliance of the produced flour. According to Luthringer et al. [16] recommended that once the premix is opened, exposure to light air and temperature should be minimized to avoid noncompliance of the flour due to drop of micronutrients. Warm and humid storage conditions including warehouses which are not climatically controlled can also affect the stability of micronutrients such as folic acid.

3.5. Maize Flour Fortification Process

The result of maize flour fortification process as shown in Table 3 indicated that only 5.3% of processors had records of feeder performance and 76.3% had no records of maize flour produced against premix used. Furthermore, feeders were adequately filled with micronutrients during fortification for all visited factory. Fortification processes requires proper use of quality assurance/control at the mill to ensure premix is adequately available in the feeder during fortification and feeder is working properly [11]. The survey also analyzed the availability of the records of dosifier calibration, 94.7% of the processors not having records of dosifier calibration was higher than the one reported in Kenya whereby only 34.9% found not calibrating their dosifier [14]. This could be due to lack of technical knowhow on how to check the performance of the dosifier including calibration. According to ECSA [11], feeder should be verified regularly under defined interval to ensure proper release of micronutrients and uniform distribution of the micronutrients in the final product which can be consistently available during storage and after food preparation.

Table 3. *Implementation of quality assurance and quality control by processors of fortified maize flour.*

Variables	Description	Implemented (%)	Not Implemented (%)
	Premix is up to date	100 (38)	0
	Premix inventory is up to date	10.5 (4)	89.5 (34)
Handling of micro-nutrient	Premix is stored under appropriate conditions[2]	73.7 (28)	26.3 (10)
	First in first out system in place	100 (38)	0
	Premix is handled well in the fortification site	100 (38)	0
	Records of feeder calibration available	5.3 (2)	94.7 (36)
Maize flour fortification process	Premix in the feeder adequate during observation	100 (38)	0
	Records of maize flour produced/premix used	23.7 (9)	76.3 (29)
	Analysis of flour using iron spot test[4]	2.6 (1)	97.4 (37)
	Analysis of flour in external lab[5]	10.52 (4)	89.48 (34)
Control of fortified maize flour	Labelling meet specification	42.1 (16)	57.9 (22)
	Maize flour stored appropriately[1]	68.4 (26)	31.6 (12)
	First in first out applied to dispatch	100 (38)	0

[1]Products stored on the pallets and out of direct sunlight. [2] products stored in cool, dry and hygienic place. [4]availability of equipments for qualitative analysis of fortified maize flour, [5]availability of test report from external laboratory

3.6. Control of Fortified Maize Flour

The control of fortified maize flour as indicated in Table 3 showed that only 2.6% of processor performs internal monitoring of fortified maize flour using iron spot test and 10.52% subcontract laboratory analysis to other institutions. It was observed that, 42.1% of fortified product complied in marking and labelling as per the recommended standard. It was also observed that, 68.4% of the processors stored their final product properly, while 31.6% were not stored over the pallets as indicated in the requirements of standard.

Effective implementations of fortification programme require proper internal and external monitoring of fortified product. Internal monitoring at the factory level requires periodic testing to ensure the desired micronutrients are available before released to the market. Iron spot test is the most common and rapid test used to verify the presence of micronutrient in the flour. The obtained results in the current study indicate that 97.4% of processors lack instruments for laboratory processors, which was higher than those reported Khamila et al. [14] who observed 30% of processors having capacity of performing internal quality check.

It was also observed that, fortified maize flour was not stored according to the recommended standard. As shown in Table 3, only 68.4% of producers stored fortified maize flour appropriately and the remaining 31.6% were stored on the floor. This can lead to decrease in some micronutrients like folic acid and reduce shelf life of final product. A storage condition of fortified maize flour is one of the factors that determine compliance and shelf life of the flour [20]. According to the requirements of the standard, fortified maize flour should be stored in appropriate condition over pallet [11, 12, 24] to avoid spoilage of the final product by dangerous moulds [22]. Likewise, the proper storage of fortified flour improves retention of less stable micronutrients such as vitamins which tends to be affected by the moisture contents due to improper handling [17]. According to ECSA manual for commercial fortified maize flour, the flour should be labelled with fortification logo, name of the fortification mill/center, address, brand, micronutrients levels, batch number and production date [11]. This is contrary to the finding of the current study of which more than half of processor (57.9%) did not comply with the requirement of marking and labeling in the area of batch number and production date as per Tanzania standard TZS328. This could be due to lack of training on the importance of internal quality assurance of fortified maize flour at the mill. Batch number and production date are the unique identifier of the specific product which are important during traceability of the product.

3.7. Challenge Faced by Processors to Attain Compliance to the Recommended Standard in Maize Flour Fortification

To explore different challenges faced by small-scale processors of fortified maize flour to attain compliance to the recommended national standards, interviews were conducted with personnel involving in fortification at factory level. The

interviewed processors explored training and fortification awareness, as the main challenges followed by laboratory capacity, workers skills and technical capability (Figure 1). During survey a total of 38 small-scale processors were interviewed, 50% of the respondents were company directors and 10.5% company managers. Other respondents were company supervisors (26.3%) and millers (13.2 %) (Figure 1).

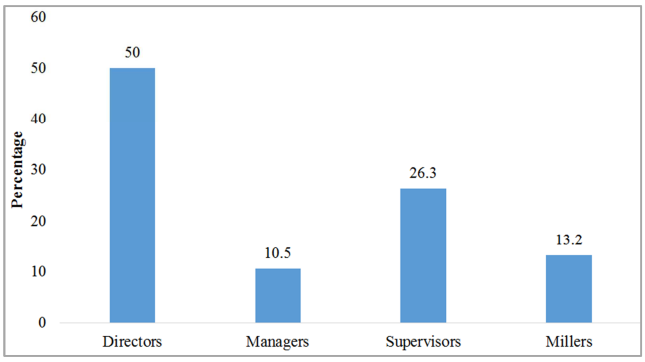

Figure 1. *Proportion of respondents interviewed from factory.*

3.7.1. Training

Training is one of the tools that enable personnel to perform better in the specified field. Majority of respondent (52.6%) reported that, lack of consistence training in the mills especially in the area of quality assurance and fortification standards as major challenges to ensure fortified flour meet the recommended standard (Figure 1). During the study, it was observed that, 39.5% of the processors were not aware of national maize flour fortification standards, while 15.8% were not conversant with the recommended standards (Table 4). It was also observed that employees in the company were not permanent which makes most of them missing the training offered by the governmental institutions. The sustainability of fortification programme is effective when effective training is implemented as it helps workers to own the programme and increases conformity to standard. The maintenance and calibration of dosifier was in line with the study conducted in Morocco whereby, insufficient training of the factory workers were identified as the main challenges to attain compliance of fortified food [4]. Also, it was reported by Luthringer et al. [16] that most processors lack trained staff with technical capability which hinders the fortification practices. Training gaps in all aspects of fortification including fortification standards, premix handling and storage, calibration and maintenance, and quality assurance practices can easily be addressed with a skilled workforce (WHO, 2021). For proper implementation of fortification programme training should be done to all workers at the factory regardless of their positions.

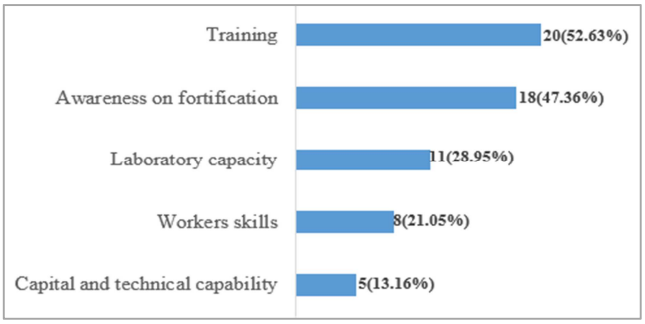

Figure 2. *Challenges faced by processors of fortified maize flour in ensuring fortification compliance (N=38).*

3.7.2. Awareness and Consumers Attitudes on Fortification

Majority of respondents (47.36%) reported awareness and attitudes of consumers towards food fortification as major challenges in attaining the compliance to the recommended standards (Figure 2). The study also observed that, more than half of the respondents 71.05% were aware with fortification practices and the rest 28.95% did not know why they are doing fortification (Table 4). Most of the respondents recommended that awareness on fortification should be ongoing process because not all of people know the importance of consuming fortified food. Majority of processors are not in fortification program because most of consumers preferred unfortified maize flour due to lack of knowledge on the benefits of consuming fortified maize flour.

It is important for both processors and consumers to be aware of the existence and importance of fortified food in order to increase the coverage of consumption of fortified food. Low level of awareness and consumers attitudes on food fortification as reported in the current study was in line with the study conducted in South Africa by Sunley and Umunna [21] in which lack of awareness on fortification among millers and poor communication among various stakeholders were identified as factors which contributed to decline of fortification programme and caused 45.3% of children aged 1-9 years to suffer from zinc deficiency.

Table 4. *Challenges faced by processors of fortified maize flour.*

Description	Frequency (N)	Percentage (%)
Ability to explain at least one clue on regarding fortification	21	55.3
Could not know why they were adding micronutrients in their maize flour	4	10.5
Not aware of national maize flour fortification standards	15	39.5
Not aware of the micronutrient fortification recommended standards	6	15.8
Awareness of fortification practice	27	71.1
Laboratory instruments for flour analysis	32	84.2

Awareness on fortification should be ongoing process because not all of people know the importance of consuming fortified food. Tanzania is surrounded by a number of small-scale processors who are not in the fortification programme due to lack of knowledge on the benefits of consuming fortified maize flour. The promotion on the importance of

processing and consuming fortified food from low to high level through radio and televisions programme as recommended by six (6) processors could produce the desired effect. This was supported by the social market campaign developed by Ministry of Health and UNICEF in 2008 aiming at raising awareness on fortification logo through television, radio and promotion materials which resulted in 61% of consumers and more than 50% of distributors to recognize fortification logo [4, 26]. In additions, the advertisement through radio and community activation in Kenya and Tanzania impacted knowledge regarding food fortification to more than 1600 reproductive aged women [18]. Marketing of fortification programme through radio contributed in raising awareness of fortified food. Impacting proper knowledge to all workers working in the mills will be the best approach since they will be ambassador to other people sourcing service from them who have never been trained or heard on food fortification.

3.7.3. Laboratory Capacity

About 29% of processors reported that, laboratory was one of challenge in ensuring fortified maize flour processed meet the recommended standard (Figure 2). Few processors (13.2%) analyze their fortified maize flour using external laboratory and only one (2.6%) had instruments for qualitative iron test. The effective implementation of fortification programme requires internal monitoring of the fortified food to make sure that, the food contains adequate micronutrients before consumption. In the current study, 85.5% of processors lack laboratory instruments for flour analysis (Table 4) to confirm its quality which was in line with the study reported by which revealed lack of laboratory instruments as the main challenges that hinder compliance. This made the fortified maize flour processed by small-scale processors to be dispatched to the market with unknown quality.

3.7.4. Worker Skills, Capital and Technical Capability

About 21% of processors reported workers skills and 13.15% reported technical capability as one of the challenges in ensuring the fortified maize flour complies with the recommended standards. Four (04) of them recommended that; having skills and technical capability especially on dosifier is very important as will help processors during technical faulty of machine instead of waiting for technician from supplier. They also said that for sustainability of fortification, it is important for the processors to own the programme. Facilitation of fortification programme to small-scale processors is project driven [24] (WHO, 2021) and they also rely on donor for supplying dosifier and premix including the technical capability on operation and management of equipment. This raise question on sustainability of the programme. Knowledge and skills of workers in different aspects of fortification is required for proper implementation of fortification programme. Poor knowledge and skills on fortification have been reported as the main causes of 10% of the mills who were found using fortification logo but were not fortifying their products [14]. Having skilled and trained workers in fortification programme especially in the area of operation, calibration and maintenance of dosifier including quality assurance, handling and storage of premixes increases the level of compliance (WHO, 2021). As the fortification was donor dependent, impacting technical knowledge and skills to processors could reduce the amount of unfortified maize flour with fortification logo in the market. This is because the study revealed that processors did not have knowledge on maintenance of dosifier when technical fault occurs and they usually inform the supplier of dosifier for rectification. At this waiting period processors proceed with maize flour processing and pack in the already printed bags with fortification logo. This causes circulation of unfortified product in the market having fortification logo. It has been reported by Berger [4] that the main challenge faced by processors to comply with fortification is lack of skills and capacity on feeder installation.

4. Conclusion

In conclusion, there was a low level of quality assurance and quality control implementation at the plant, particularly when it came to the internal and external analysis of the factory's maize flour that could be caused by lack of laboratory capacity and high cost of analyzing flour by contacting external laboratory. In addition, 97.2% of processors stored fortified maize flour and premix under unfavorable storage conditions, which resulted in the loss of micronutrients such as folic acid. The lack of procedure or instruction for various fortification-related processes and inadequate training on production practices including cleaning and sanitation to workers working in production area led to the marked low level of compliance in maize flour fortification with micronutrients. Strengthening of quality assurance and quality control practices to small scale processors is recommended in order to ensure that the targeted groups of people receive safe and quality fortified maize flour with adequate micronutrients.

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Conflicts of Interest

The authors declare no conflict of interest.

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