Ensuring the safety of complementary foods produced at community level using locally available ingredients in Ethiopia

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ABSTRACT

Aflatoxin, a type of mycotoxin, contamination may impair gut permeability, reduce nutrient bioavailability and exacerbate micronutrient deficiency. Considering the potential health risks of mycotoxins and microbes (such as E. sakazakii), total coliforms and E. coli) we implemented this study to assess potential risks for contamination of complementary food (CF) produced in a community-based pilot project in four regions of Ethiopia.

Relevant knowledge, attitudes and practices (KAP) were assessed using structured questionnaires among 200 mothers/caregivers of young children. Moreover, 146 CF samples from 20 pilot sites (pre-milling=66, immediately post-production=20, one-month post-production=40, and purposely selected moldy=20) were tested for E. sakazakii, total coliforms, E. coli and total aflatoxins. Hazards Analysis Critical Point (HACCP) protocols were developed to ensure safe CF preparation.

Total aflatoxins were detected in almost all (144 out of 146) of the samples. Although only five out of 146 samples surpassed the maximum limit (10 ppb), even such a level may cause health problems to young children. The levels of total aflatoxin and microbes increased during the one month storage in households and grain banks across all the regions. KAP indicated many families feed moldy staples to animals and children. All moldy samples collected contained unsafe levels of microbes. These findings indicate serious risks to young children directly or through animals fed contaminated staples from household and through the CF production.

Thus, the HACCP-based protocols developed need to be implemented strictly to ensure the safety of CFs and minimize the adverse effects caused in young children and their families.

BACKGROUND

Ethiopia has one of the highest rates of under nutrition in Sub-Saharan Africa (40% <5yrs, CSA, 2014). Growth faltering reaches its peak between 6-23 months of age, during the period when CFs are often introduced, indicating that inappropriate introduction and patterns of complementary feeding may contribute to the problem. Recognizing this gap, UNICEF-Ethiopia and partners developed a project for the local production of CFs that would optimize the nutritional intake, and thus status, of children 6-23 months in rural and semi-urban settings of Amhara, Tigray, Oromia and Southern Nations Nationalities and Peoples (SNNP) regions.

Production and distribution through both the rural and urban grain bank (GB) models have been introduced and accepted by the communities, but there are concerns with regard to the level of mycotoxins, including aflatoxin, of the cereals and legumes used for the preparation of CFs. Susceptibility to aflatoxin is greatest in young children and may contribute to growth faltering and hepatocellular carcinoma later in life. Hence, reducing the levels of aflatoxin exposure among young children during early life is a goal worth achieving.

OBJECTIVES

To investigate the safety of CFs with regards to aflatoxin, C. sakazakii, total coliforms, and E. coli, and develop HACCP-based SOPs for preventing CFs from the risks of mould, aflatoxin and microbial contamination.

METHODS

Survey was conducted to identify knowledge and practices that contribute to the contamination of CFs raw materials and CFs with aflatoxin and other microorganisms (pre-harvest, harvest, storage, household and grain banks):

- The questionnaire was translated into three local languages and reviewed/approved by various stakeholders.
- 200 respondents from 10 villages in each of 20 extended piloting areas in Amhara, Tigray, Oromia and SNNP.
- Respondents in rural settings were mothers/caregivers of children – 6 to 23 months, who were recipients or trained to process CFs.
- Urban respondents were mothers who had been working at the grain bank processing centers.

Sample collection:

Four types of samples (Table 1) were collected in two randomly selected rural villages across all the piloting Woredas.

- 2 kg of each sample were collected in the field (grainbanks: GBs and households: HHs) in paper bags and kept in polyethylene bags with 300 gms desiccant (self-indicating silica gel) and kept together in a plastic box with lids for transport from field to lab. All 146 samples were collected in two rounds (Table 1) across the four regions.
- Out of each 2kg composite sample, 200gms was shipped to the Center for Disease Control and Prevention, USA, for aflatoxin analysis.
- The remaining samples were used for microbial analysis at the AAU.

Biochemical analyses:

- Total aflatoxins in all the samples were determined using enzyme linked immunosorbent assay (ELISA) based on the method described by Iqbal S et al. (2014) [4].
- C. sakazakii was detected from the food samples based on the method ISO/TS 22964:2006 [2].
- Total coliforms and E. coli were analyzed by using the conventional method called Most Probable Number (MPN) method according to FAO (1997) [8].

RESULTS

Researchers reported good knowledge and practice of good agricultural practices: ploughing, crop rotation, and removing old derelictated heads/stalks.

- The most common threshing methods used were trampling by hoofed animals on a threshing floor, which is susceptible to contamination by animal’s excrements and other microorganisms.
- Common storage methods: ‘Gota’ (cylindrical chamber of straw and mud), ‘Gotera’ (woven storage space with thatched roof), and underground pit, all of which are susceptible to mould spoilage and aflatoxin contamination.
- Mould spoiled cereals and legumes were reportedly used as an animal feed, particularly for chickens that are then consumed and to prepare CFs during lean seasons, and to prepare local alcoholic beverages.
- Total aflatoxins were detected in 140 out of 146 of the samples. As expected, the levels and occurrence of total aflatoxin were higher in mouldy but lower in freshly cleaned pre-milling samples. The levels of total aflatoxin were also increased in CFs from post production to following one month storage in HHs and GBs across all regions (Figure 1).

- Only five out of 146 samples exceeded the acceptable limit (20 ppb).
- C. sakazakii was detected in 11% (16/146) of the samples collected, while 45% and 6% of the samples collected were positive for total coliforms and E.coli, up to a maximum of 100 CFU/ml and 150 CFU/g respectively.

CONCLUSIONS

Although reported agricultural practices were positive, respondents did not appear to understand the potentially toxic effects of directly or indirectly consuming contaminated foods, or animals who had consumed these foods, on the health of humans and animals. Identification of C. sakazakii in one of every ten CF samples is a major health risk that must be addressed through improved growing and hygienic practices.

- Identification of more contamination post-production implies that poor hygienic practices or cross-contamination from production equipment, such as the mills, may be contributing to contamination in both households and grain banks.
- Although few samples exceeded a toxic level for aflatoxin, its presence in nearly all samples (140 of 146) indicates storage is a particular concern.
- Although aflatoxin levels were considered safe for consumption in most samples (all but 5 of 146), more effort should be implemented to reduce these contamination levels, particularly as these CFs are intended for direct consumption by young children.
- Education and other support must continue to identify, remove and prevent proliferation of aflatoxin and other mycotoxins in the CFs produced in these programs.

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TABLE 1: Samples collected across all the regions for aflatoxin and microbial analysis

<table>
<thead>
<tr>
<th>Region</th>
<th>Pre milling</th>
<th>Mouldy</th>
<th>Post production</th>
<th>Post production one month stored</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cereals</td>
<td>Legumes</td>
<td>Cereals/legumes</td>
<td>CFs at HH</td>
<td>CFs at GB</td>
</tr>
<tr>
<td>Amhara</td>
<td>15</td>
<td>9</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Tigray</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Oromia</td>
<td>12</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>SNNP</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>25</td>
<td>20</td>
<td>20</td>
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REFERENCES