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IMPROVING HANDLING PRACTICES AND MICROBIOLOGICAL SAFETY OF MILK AND MILK PRODUCTS IN BORANA PASTORAL COMMUNITIES, ETHIOPIA

Background

This research project was co-led by Addis Ababa University and the International Livestock Research Institute with the aim of improving the handling practices for milk and dairy products among pastoralists in southern Ethiopia. Unsafe milk can result in transmission of pathogenic germs, leading to human diseases (for example, *E. coli* O157:H7 causes diarrheal illness and occasionally life-threatening kidney problems). Improved milk handling and processing can help reduce foodborne disease and ensure the safety of animal-source foods.

People in Borana pastoral communities handle and process milk and milk products in traditional ways, such as smoking of milk utensils for cleaning and for imparting the desired flavor. However, the effectiveness of such traditional practices on milk safety has not been investigated. Moreover, the acceptability of storing milk in alternative containers (stainless steel or aluminum) is unknown.

The objectives of this project were 1) to improve knowledge, attitudes, and practices of women regarding milk consumption and handling and the associated health risks particularly from two important zoonotic diseases (tuberculosis and brucellosis), and 2) to assess the sociocultural acceptability of stainless steel containers for the preparation of traditional fermented milk (yoghurt) among pastoralist populations; 3) to assess the effects on the microbial quality of yoghurt of smoking traditional milk containers using wood from three tree species (*Olea europaea* subspecies *cuspidata*, *Faurea speciosa* and *Terminalia brownii*) versus storing it in stainless steel containers, and 4) to assess levels of raw milk contamination with pathogenic bacteria (*E. coli* O157:H7 and *Salmonella* species) and their antimicrobial resistance.

Approach

In the Borana zone, 120 pastoralist women were trained on proper milk hygiene, consumption and methods to prevent milk-borne zoonotic diseases. The effects of the training were assessed by evaluating the knowledge, attitudes and practices of the trainees before, immediately after, and 6 month later, using a structured questionnaire. One experiment assessed the effect of replacing traditional smoking method versus storing milk in stainless steel on the microbial load of traditional yoghurt. A second experiment examined the cultural acceptability of the yoghurt made in both ways in the first experiment. In these participatory experiments, selected trainees prepared traditional yoghurt using both traditional and stainless steel containers and the microbial load was assessed and compared. The traditional containers were made from three tree species and smoked before use in the traditional way. The cultural acceptability of stainless-steel milk containers was assessed via a qualitative investigation. Another experiment assessed the suitability of aluminum containers for preparing traditional yoghurt by examining leaching of aluminum from the container into the in raw or fermented milk.

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Project area: Yabello District of Borana Zone, Oromia Regional State, Ethiopia. Borana is a pastoral and an agro-pastoral area and livestock production plays a key role in the livelihoods of the community. Various livestock species including cattle, camels, sheep, goats and equines are kept by the community.



A final experiment assessed raw milk contamination at the level of primary production. A total of 484 samples (150 samples each of cow milk and feces and 92 samples each of camel milk and feces) were collected to test for the occurrence of *E. coli* O157:H7 and *Salmonella* species and their resistance against various antimicrobials.

Results

Assessment of change in knowledge, attitudes and practices of pastoralist women: In the pre-training assessment, the knowledge on milk hygiene and milk-borne diseases was high, but the incidence of positive attitudes and correct practices was low. The training intervention improved the knowledge, attitudes and practices of the participants for most of the aspects related to milk hygiene and milk-borne zoonoses, and these changes were statistically significant. However, one-third of the trainees maintained a negative attitude to the recommended practices, and a quarter of them reported wrong practices in the post-training assessments.

Effect of smoking on microbial load: No statistically significant difference ($p < 0.05$) was found in microbial load or quality attributes of fermented milk (traditional yoghurt) based on container type. Moreover, no differences were found in microbial load based on wood type used for smoking of the milk containers.

Suitability of aluminum containers for traditional yoghurt making: The tests showed that preparing traditional yoghurt products in aluminum containers can lead to leaching of aluminum into the yogurt, which could be a potential health risk for consumers. The mean aluminum content in fresh milk on the day of storage in the aluminum container was 3.36 ± 1.33 mg/l and it increased over time. Mean values on days 3, 5 and 7 of fermentation were 5.58 ± 1.44 , 8.74 ± 1.64 and 11.81 ± 2.84 mg/l, respectively. Yoghurt aluminum concentrations on days 5 and 7 were 3.14 and 6.47 times more than those on day 3. The US Food and Drug Administration limit for aluminum in drinking water is 0.2 mg/l.

Qualitative research examining the social acceptability of stainless-steel containers: There was a strong preference by pastoralists for milk stored in traditional containers rather than stainless steel, due to the flavor/taste imparted by the smoked traditional containers, the possibility to decorate traditional containers, and perception that the traditional containers maintained a more conducive temperature for optimal milk fermentation. Therefore, stainless steel containers may not be accepted and adopted by the pastoralists.

Occurrence and antimicrobial resistance of pathogens in feces and raw milk of lactating animals: Testing indicated that the prevalence of *E. coli* O157:H7 was 4.7% in both milk and feces samples in cows, while it was 3.3% for camel fecal samples. The prevalence of *Salmonella* ssp. was 4.0% in cow milk samples and 8.6% in cow fecal samples, while in camel milk or fecal samples prevalence was 1.1% and 2.1%, respectively. Testing revealed that 92.9% of *E. coli* O157 and 15.8% of *Salmonella* isolates from cattle showed resistance to two or more antimicrobial agents. Resistance to multiple antimicrobials was found for 66.7% of *Salmonella* isolates from camel samples. Antimicrobial resistance was the highest for ampicillin (100% of isolates from both species) followed by Tetracycline (58.8%) for *E. coli* O157 in cattle.

Recommendations

Stainless steel containers may not be culturally acceptable in pastoral communities and based on the limited experimental evidence from this project, they do not seem to have reduced microbial load relative to traditional containers. The training intervention was promising in terms of improving knowledge, attitudes and practices of the pastoralists related to milk hygiene. It is recommended to repeat the trainings and complement them by providing adoption incentives and by creating an enabling environment, with more readily available sanitation facilities and clean water. Antimicrobial resistance was evident in raw milk and feces of cows and cattle, posing a concern for both animal and human health. Capacity building on appropriate use of antibiotics and other best management practices should be included as an important intervention as part of Ethiopia's livestock development plans.

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