Chapter 2:

Application of HACCP to the supply and processing chain of Horro beef animals in Ethiopia[1]

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Abstract

Prototype studies with the objective of Hazard Analysis and Critical Control Point (HACCP) application in the Horro beef production to consumption chain were conducted in Ethiopia. The chain involved terminal market for sales of slaughter stocks, carcass dressing line in Addis Ababa abattoir (AAA) and butcheries concerned with retailing of the derived carcasses. At first, baseline microbial data to implicate hygienic level of the process chain were collected and then potential hazards identified. Enumeration involved aerobic plate (AC), Enterobacteriaceae (EC) and coliform (CC) counts. From each plate of enumeration, randomly picked 8-12 colony forming units (CFU) were subjected to Analytical Profile Index (API 20E) biochemical test strips for characterization of the hazard. At latter stages, additional samples were collected following similar procedures of the enumeration work for selective detection of specific hazards expected in slaughter stock and the derived carcass processing environment. Samples were selectively enriched and immunomagnetic separation (IMS) assay performed. Post-IMS cultures bead matrix were sub-cultured and final identification of confirmed hazards were carried out using Microbact GNB 24E (MB1074A, Oxoid), 12L (MB1128, Oxoid) and 24E (MB1132, Oxoid). The pure cultures of all categories of isolates were serotyped based on the reactions of somatic or cell wall (O) and flagellar (H) antigens.

Enumeration data indicated that process stages had significant ($p < 0.05$) effects on AC, EC and CC. The mean log CFU ranged from 3.567-4.128, 3.742-4.059, and 3.757-4.037 CFU/cm^2/g^2 respectively for AC, EC and CC. The incidences of the hazards varied between 10.4 and 22 % for Klebsiella pneumoniae and E. coli O157:H7, respectively. Hazards were distributed along all process stages studied. Following the principles of HACCP, critical control points and limits were

identified and monitoring and evaluation procedures suggested based on the results. It was recommended that stakeholders could help the goal of HACCP implementation achievable, especially the State of Oromia and the Federal Government of Ethiopia could formulate policy either for mandatory or voluntarily HACCP application in both domestic and export abattoirs. The practice of a full scale HACCP plan should prevent hazards which may endanger consumer health and also increase competence of the country's beef export potential in the global trade market.

Key words: Horro beef; Addis Ababa; Abattoir; Hazard; HACCP; Oromia; Ethiopia

2.1. Introduction

Beef is the most favored food consumed in Ethiopia often uncooked. The slaughter beef stocks are purchased from extensive or semi intensive-management systems and either trekked or trucked to slaughter points. Based on the recommendation of Solomon (1975), the official veterinarians visually assess *ante mortem* and *postmortem* inspection. Approved carcasses are stamped, immediately loaded onto trucks and dispatched to butcheries for retailing. Obviously, such gross inspection is not a strict way to assure safety of the carcass processed from production to consumption chain (Asseged et al., 2004). Under such unreliable inspection systems, spoilage of the beef and public health issues endangered by beef-borne hazards may become an issue and calls for increased attention.

Butchery men in Addis Ababa purchase Horro beef animals and submit them to the Addis Ababa abattoir (AAA). Purchased animals are tagged, transported and unloaded at the lairage of AAA for slaughter. After slaughter and dressing service at the AAA, the butchers receive the carcasses for retailing in their butcheries. Thus, substantial numbers of Addis Ababa city dwellers depend on the supply

and retailing of carcasses of Horro beef animals. However, the extent of exposed, sickened and/or deceased consumers and the potential cost of beef-borne illnesses in the country is not well documented. Neither level of safety nor epidemiological data following the supply and processing chain of Horro cattle slaughter stock were documented. The fact that beef is often consumed uncooked in Ethiopia may increase the risk posed by beef-borne pathogens on consumers' health. Also there is need for the country to improve the safety of carcasses, not only for domestic consumption but also to comply with international beef export trade standards.

Despite the demand for improved safety standards, the health risk posed by microbial hazards is ever increasing (Notermans et al., 1995). In most food processes the points where food becomes a microbiological hazard are few, and these points can be specifically controlled and monitored once identified (Kilsby and Pugh, 1981). As a remedy for the threat, Hazard Analysis and Critical Control Point (HACCP) is a most effective means for preventing microbial contamination of meat carcasses during slaughter (Bolton et al. 2002). HACCP is an optimal framework for building science-based process control (s) to prevent food safety hazards in food production systems (FSIS, 1996). It would be beneficial for each slaughter facility to develop its own baseline reference data on hazards or potential hazards and customize available generic HACCP plans to match site specific circumstances and processes (Vanne et al., 1996). Hence, an effective HACCP system must be based on accurate baseline data on the types and levels of potential contamination at each stage of production (Gill et al., 1996) as processing plants differ in terms of the range and levels of contamination present (Vanne et al., 1996).

However, no published reports on the specific hazard type and levels of contamination in Ethiopia are available following the supply and process chain of Horro beef to enable identification of severity or the risk category. Stages at which the microbial hazards colonize the beef carcasses also deserve

investigation as these would help to demarcate critical control points and set limits beyond which occurrence of the hazard would either risk public health, incur economic loss or both possibilities. Therefore, application of generic HACCP to the Horro beef production to consumption chain is a prototype study which can be implicated as a useful tool not only for production of safe beef but also to minimize consumers' health risks. Moreover, it would provide a baseline investigation beneficial to enable the country to compete for safe beef export markets as such experience could further be adopted by export abattoirs. Hence this study was conducted with objectives to identify microbial hazards, characterize associated risks, and set critical control points and critical limits of the hazard *per se* so as to enable application of HACCP as a tool to minimize risk to the public of disease(s) caused by the potential microbial hazards.

2.2. Materials and methods

2.2.1. Description of the supply chain and slaughter operation

The study was conducted following the supply chain of Horro beef slaughter stock to Addis Ababa abattoir (AAA). The AAA, located in Addis Ababa city (9.03^0 N 38.7^0 E), is a high throughput carcass processing center. The abattoir is mandated to provide slaughter services for retailer butchers based in Addis Ababa city for in city carcass retailing. An initial meeting was held with staff members of the slaughter division of the AAA to develop flow charts of the Horro slaughter stock supply chain, carcass dressing operation in the abattoir, and its distribution to develop plans for sampling and assessing hazards as well as to discuss issues deemed necessary.

The following points were made clear.

1. Species and identity of the stocks slaughtered in the AAA
2. Flow chain of the Horro cattle slaughter stock
3. Lairage and carcass dressing line flow steps

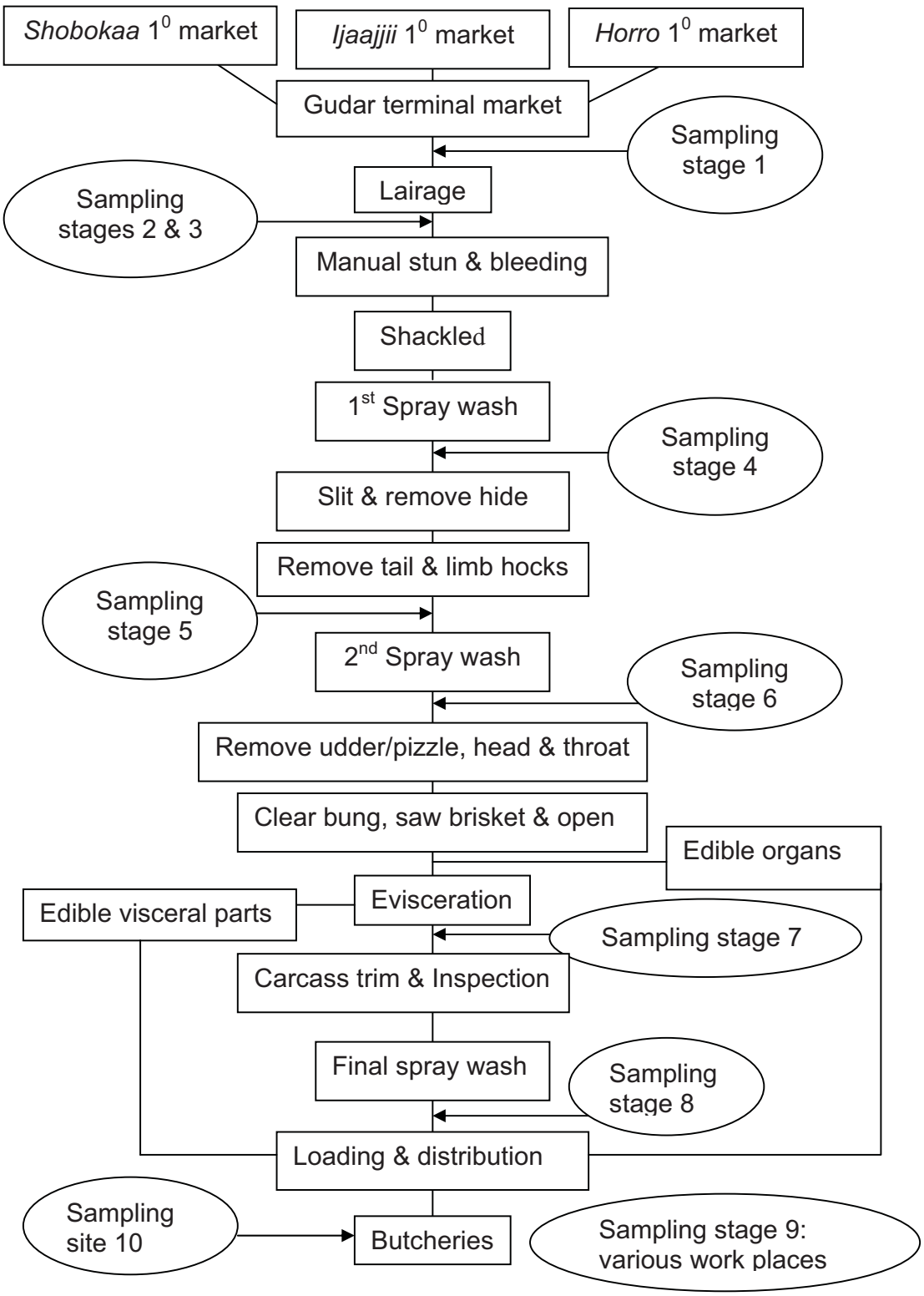

Figure 2.1. Flow diagram of Horro beef supply chain, carcass dressing and