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SURVEY ON THE POSSIBLE CRITICAL CONTROL POINTS DURING THE PRODUCTION OF *BALANGU* IN KANO

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ABSTRACT
Hazard, and critical control point (CCP) analysis was carried out during the production of balangu (a locally produced roasted meat product) in Kabuga, Gwale Local Government area of Kano State Nigeria. The analysis consisted of the aerobic mesophilic bacterial count, fungal count, and detection of E. coli, Salmonella and Clostridium perfringens on the raw meat before processing and the roasted meat. The raw meat was found to have counts above the (FAO 1979) acceptable limit (10^7cfu/g). Bacteria isolated and biochemically characterized are Staphylococcus spp, coliforms, Salmonella spp and Clostridium perfringens. Presence of these organisms is potentially hazardous and pose risk to consumers of the product. The roasted meat (the finished product) have relatively low counts. The counts from raw meat were, aerobic plate count (APC) = 1.73 E8 cfu/g, and fungal counts (FC) = 2.02 E7 cfu/g, then Staphylococal count (SC) = 7.00 E8 cfu/g, in addition to the isolation of E. coli, Salmonella spp and Clostridium perfringens. The raw meat is therefore regarded as a critical control point. It is therefore recommended that meat handlers and operators at abattoir, should exercise personal and environmental hygiene as well as use clean utensils so as to eliminate any possible hazard or reduce it to an acceptable level.

Key words: Hazard and Critical Control Point, Bacterial count, Fungal count, Pathogenic bacteria, balangu, Kano.

INTRODUCTON

Balangu is one of the traditionally prepared meat products produced and widely consumed in Northern Nigeria. It is produced by spreading raw meat on wire gauze and roasted on barbeque with addition of seasoning and oil.

Hazard analysis and critical control point (HACCP) is a management system in which food safety is addressed through the analysis of biological, chemical and physical hazard, from raw material, processing, procurement and handling, to manufacturing, distribution and consumption of the finished product (National Advisory Committee on Microbiological Criteria for Foods,1997). This analysis actually involves the close and thorough monitoring of all production stages of the product, so as to determine the particular stages at which hazard exists, establish the critical control point and suggest possible control measures. So in essence, HACCP system is a useful tool in promoting food safety (Plahar *et al.,* 1999). According to Oranusi *et al.,* (2003), to develop a better understanding of the microbiological problem associated with a food production process, it is extremely necessary to apply HACCP strategy.

Even though meat from a freshly slaughtered healthy animal, supposes to be free from pathogenic microbes (Adams and Moss, 1995), laboratory evidence suggests that they could be contaminated to an unsafe level at the point of consumption (Umoh, 2001). This work is therefore set up with the aim of determining the quality characteristics of *Balangu*, so that recommendations could be made on its safety accordingly.

MATERIALS AND METHODS

Sampling site

The product (*balangu*) was sampled from Kabuga Gwale Local Government area. This place is well known for the production and sale of this product.

Sample collection

Samples of raw meat were collected from the *Balangu* producers just before roasting and the roasted meat samples were collected using the method of FAO, (1979). Swab sticks were used for the collection of swab material from the hands and the knives of the handlers. Twenty (20) samples each of both raw meat, roasted meat and swabs were collected on different occasions (Abdullahi *et. al.*, 2004).

MICROBIOLOGICAL ANALYSIS OF SAMPLES

Swab analysis

Four milliliters (4ml) of peptone water was poured into each of the swab stick tube. This was labeled as the stock homogenate. The stock was serially diluted from 10^{-1} to 10^{-5}. From each of the serially diluted tubes, 1ml of inoculum was transferred into separate correspondingly labeled Petri dishes.

This was followed by pouring of molten nutrient agar and malt extract agar for aerobic plate count and fungal count respectively in duplicates. The stock was also cultured on eosine methylene blue agar for *E. coli* detection.

Preparation of homogenate

The sample preparation was carried out according to the method described by FAO (1979). Here, 25g of the sample (meat) was weighed and homogenized by blending in 225ml buffered peptone water at 15,000-20,000 rpm. This was labeled as 1:10 dilution, (the stock or the homogenate). This was further serially diluted up to 10^{-8}. The serially diluted samples were subjected to such microbiological analysis as standard plate count (using nutrient agar), Staphylococcal count (using Baird parker agar), coliform count (using MPN), fungal count (using malt extract agar), detection of *E. coli* (using EMB), *Salmonella spp* (using brilliant green agar after enrichment with selenite cysteine medium) and *Clostridium perfringens* (using neomycin blood agar)..

Detection of *E. coli* O157:H7

Isolates that formed green metallic sheen on EMB were streaked on Sorbitol Mackonkey agar and incubated at 37ºC for 24 hrs. After incubation the plates were observed for the presence of colorless colonies, for subsequent confirmation using latex agglutination test for confirmation of *E. coli* O157:H7 (Cheesebrough, 2000).

Biochemical Tests for the Characterization of the Microorganisms Isolated

Isolates *E. coli*, *Staphylococcus aureus* and *C. perfringens* were biochemically confirmed using indole, coagulase, and catalase tests as described by Cheesbrough (2000). Suspected *Salmonella spp* colonies were also tested for motility after which they were cultured on Kligler iron Agar slant and observed for glucose fermentation (no lactose fermentation) and gas production after 24 hrs incubation.

Determination of the Critical Control Coints

All the steps involved in the | production were carefully studied. The result obtained from the microbiological analysis of each step was compared with the CCP decision tree (U. S. National Advisory Committee on Microbiological Criteria for foods, NACMCF 1997), to establish whether that step is a critical control point or not. Below is the CCP decision tree.

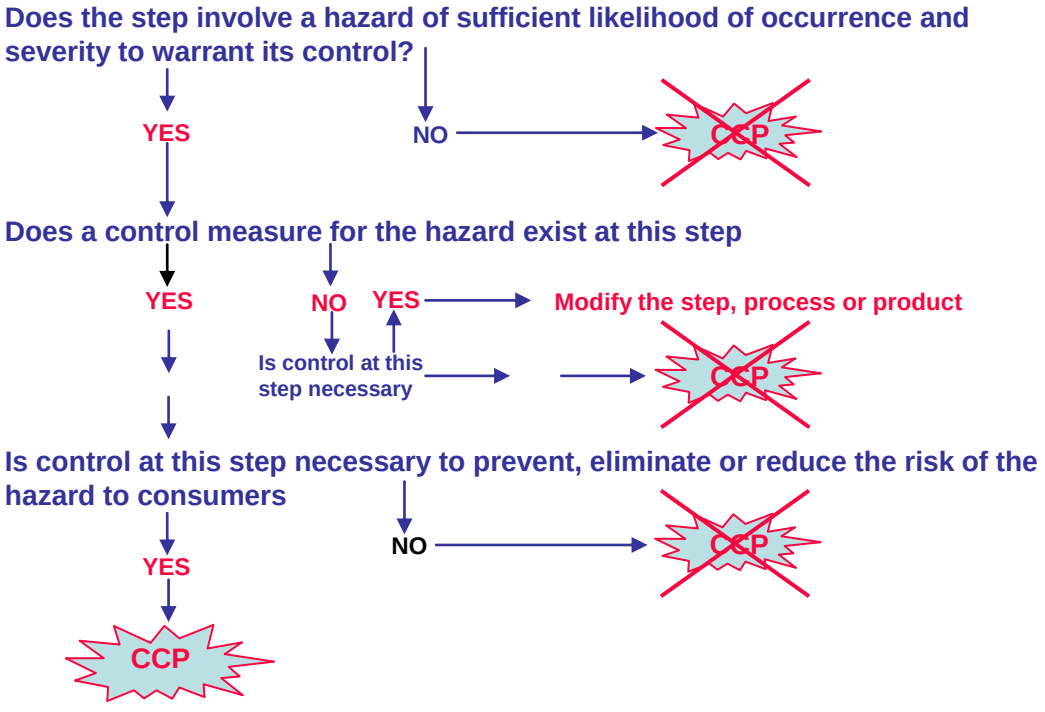

Figure 1: Critical control point decision tree Source: (NACMCF, 1997)

RESULTS

Microbiological and hazard analysis of *balangu*.

The results of the microbiological analyses of *balangu* are presented in Tables 1 and 2.

In Table 1, knives, tables and hands from *balangu* makers had APC and FC of <30 cfu/ml, <30cfu/ml and 3.10 E2 cfu/ml respectively, and FC of <30cfu/ml. No *E. coli* was isolated from knives and tables, but out of 20, 10 hands yielded *E. coli*.

In Table 2, the raw meat used in *balangu* making had mean APC of 1.73 E8cfu/g, SC of 1.73 E8 cfu/g, FC of 2.02 E7 cfu/g and >2400 MPN of coliforms/gram *E. coli* was isolated from five samples, *Salmonella spp* from five and *Clostridium perfringens* from seven samples. The roasted meat had mean APC of <30 cfu/g, SC of <30 cfu/g, FC of <30 cfu/g and 0-9 MPN of coliforms/gram. *E. coli* was isolated from one sample, no *Salmonella spp* or *Clostridium perfringens* was isolated (Table 2).

Table 1: Microbiological analysis of swabs from *Balangu* makers.

n=20	APC (cfu/ml)	FC (cfu/ml)	*E. coli*
Knives	<30	<30	-
Tables	<30	<30	-
Hands	3.10 E2	<30	10

Key: APC = Aerobic plate count, FC =Fungal count, cfu/ml = colony forming unit per milliliter, E = Exponential (ie, Ey = x10^{y}).

Table 2: Microbiological analysis of *Balangu*.

	Microbial count (cfu/g)			MPN/g	Identified microorganisms			
n=20	APC	SC	FC	CC	*E. coli*	*Salm.*	*E. coli* O157:H7	*C. perf.*
Raw	1.73 E8	7.00 E8	2.02 E7	>2,400	05	05	00	07
Roasted	<30	<30	<30	00-09	1	00	00	00

Key: APC = Aerobic plate count, SC = Staphylococcal count, FC =Fungal count, CC = Coliform count, cfu/g = colony forming unit per gram, E = Exponential (ie, Ey = x10^{y})

Identification of Critical Control Points

The critical control points were determined based on the results obtained and using the critical control point decision tree provided by the United States National Advisory Committee on Microbiological Criteria for foods (NACMCF 1997). Below is the floor diagram of *balangu* production and the identified critical control points.

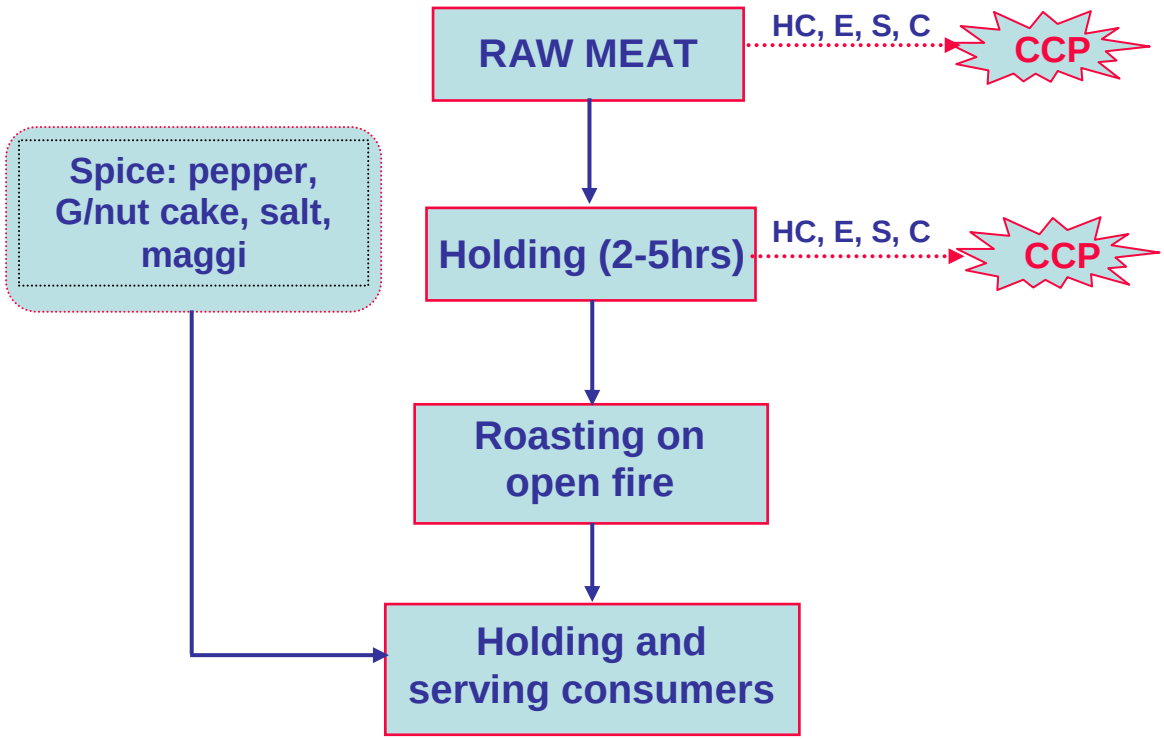

Figure 2: Flow diagram of balangu manufacture with the identified CCP.

Key: CCP = Critical control point, HC = High counts, E = *E. coli*, S = *Salmonella spp*, C = *Clostridium perfringens*.

DISCUSSION

The major microbiological hazards identified in this study are the presence of high microbial population on the raw meat (APC= 6.21.73 E8 cfu/g, SC= 7.00 E8 and >2400 MPN/g of coliforms), as well as the presence of potentially pathogenic bacteria like *E. coli*, *Salmonella spp* and *Clostridium perfringens.* (Table 2). The values of the counts from raw meat were found to be higher than the maximum acceptable values provided by the FAO, (1979), according to which aerobic plate count should not be in a number exceeding 10^7cfu/g, and *Salmonella spp* should not be isolated. Abdullahi *et. al.,* (2004); Shamsuddeen and Yusha'u, (2006) reported the presence of high bacterial load as well as presence of coagulase positive Staphylococci in raw meat samples in Zaria and Kano respectively.

The microbial populations of the meat product immediately after roasting dropped down drastically as compared to values obtained in the raw meat (APC of <30 E3cfu/g). This is not an unexpected outcome as heating generally destroys and reduces microbial cells (Umoh, 2001).

The aerobic plate count of the processed meat should not be in a number exceeding 10^4cfu/g and *Salmonella* should not be recovered. This agrees with the work of Abdullahi *et. al*., (2004), who also reported the presence of pathogenic microorganisms like *Staphylococcus aureus* in *Kilishi* in Zaria.

Based on the critical control point decision tree (NACMCF, 1997), a step is considered as a critical control point if it involves a hazard of sufficiently likelihood of occurrence and severity to warrant its control, and the control measure exists and the control is necessary in order to eliminate or reduce the hazard to an acceptable level. According to Adam and Moss (1995), even a raw material or a product can be a critical control point. Therefore, base on the CCP decision tree (NACMCF, 1997), the raw material itself in this study (raw meat) is a CCP since there was high bacterial count (APC=1.73 E8 cfu/g), which is of course higher than acceptable limit (10^7cfu/g) provided by the Food and Agriculture Organization (FAO 1079) of the United Nations as well as high coliform count (>2400 MPN/g). From this work it was clearly observed that, the initial point of contamination of raw meat was the abattoir, where meat is not handled hygienically. Putting meat on the abattoir floor, which is not clean, as well as mixing the carcasses with intestinal contents are all suggestive of the unhygienic conditions of the abattoir. All these could have contributed to the high microbial populations on the raw meat obtained in this study. Other factors include the use of non clean cutleries and utensils as well as leaving the meat exposed to the out side environment; hence comes in contact with flies and dust. Inadequate cleanliness of the entire environment in which the meat is being processed is another contributing factor for the high microbial load as well as organisms that are potentially pathogenic. According to Umoh (2001), in almost all abattoirs and slaughterhouses in Nigeria, slaughtering, skinning, evisceration and cutting of the carcasses into large chunks of meat are done on the floor, and many abattoirs do not have regular supply of potable water. On the other hand, Abdullahi *et. al.* (2004), reported that processing of products in a filthy environment could present a risk.

Conclusion and Recommendations

The major hazards at the various stages of *balangu* production are the presence of high microbial load (>10^7cfu/g) and organisms that are potentially pathogenic like *Staphylococcus aureus, Salmonella spp* in the raw meat. These stages are CCP because control measures exist, and the measure must be applied in order to eliminate or reduce the hazards to an acceptable level. It is therefore recommended that:

The meat handlers should exercise environmental and personal hygiene in all operations, and mixing of meat with intestinal contents should be avoided. Adequate supply of potable water and maintenance of cleanliness in abattoir should be ensured since it is the primary source of contamination. Dust and flies should be denied access to the meat and spices during holding before and after roasting.

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