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Hygienic-Sanitary and Good Manufacturing Evaluation of Chicken Cuts Marketed In Chókwè City

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A B S T R A C T

This study assessed the hygiene and health conditions of chicken cuts sold in Chókwè city. The checklist method was applied following Resolution RDC No. 216/04 to assess the hygiene and health conditions, verifying the adequacy or otherwise of the items evaluated. When the checklist was completed, the following was considered: (C) "Compliant" - commercial establishments that met a specific requirement, (NC) "Non-Compliant" - commercial establishments that did not comply with the observed requirement and (NA) "Not Applicable" for the requirement that was not met by the establishments surveyed. The results showed that the highest levels of compliance (20 to 100%) were found for the items building, facilities, equipment, furniture and utensils, sanitization of facilities, equipment, furniture and utensils, control of vectors and urban pests, water supply, waste management, handlers, raw materials and packaging, storage/preservation, display of meat except for documentation and registration. It can, therefore, be concluded that the establishments comply with good manufacturing practices.

Contribution to Sustainable Development Goals (SDGs)
SDG 3: Good Health and Well-Being
SDG 6: Clean Water and Sanitation
SDG 8: Decent Work and Economic Growth
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 15: Life on Land

1. INTRODUCTION

1.1. Research Background

Chicken meat is widely available on the market and accessible due to its relatively low cost. However, its composition provides ideal substrates for growing foodborne pathogens and spoiling microorganisms [1].

In Mozambique, chicken meat contributes significantly to the food security of many families considered poor (low-income) and has a high economic nutritional value for these families [2].

Due to its high biological value, meat serves as a substrate for the multiplication of countless microorganisms, and many factors can favor microbial multiplication, such as the various operations that meat undergoes before it is sold, which can compromise the quality of the final product.

Food safety is a subject of extreme importance and is discussed all over the world. Responsibility for its realization lies with all the collaborators involved in the production process, from farmers, transporters, handlers, manufacturers, the State and all government spheres, and finally, consumers [3].

Foodborne illnesses are caused by contamination and occur at any stage of the food production, delivery, and consumption chain. Most present as gastrointestinal problems, although they can also produce neurological, gynecological, and immunological symptoms [4].

Due to the occurrence of outbreaks of Foodborne Diseases (FBD) in Mozambique, the need to assess the hygienic and sanitary conditions of establishments was realized, as meat is a product most consumed by the population, with characteristics of high perishability due to its high activity of water and nutrients [5].

Good Manufacturing Practices (GMP) are measures that industries and food services adopt to ensure adequate sanitary conditions and compliance with technical regulations for food products [6]. The hygienic conditions of meat commercialization are not always in line with the appropriate hygiene standards to guarantee the products' quality and consumers' health.

However, the hygienic and sanitary conditions of meat processing establishments, handlers, distributors**,** and retailers are also critical risk points for meat quality. However, many marketing points do not observe these prerequisites [7]. In this context, there is a need to assess the suitability and application of good manufacturing practices in establishments selling chicken cuts in Chókwè City.

2. MATERIALS AND METHODS

2.1. Study area

The study was carried out in the communities of Chókwè city at the chicken shops. The Chókwè district is located in the south of Gaza province, on the middle course of the Limpopo River, with the Limpopo River as its northern boundary, which separates it from the districts of Massingir, Mabalane and Guijá; to the south, the district of Bilene and the Mazimuchope River, through the districts of Bilene, Chibuto and Xai-Xai; to the east, it borders the districts of Bilene and Chibuto; and to the west, the districts of Magude and Massingir [15].[8].

2.2. Sample size determination

The size of chicken cut shops was determined using expression 1, based on the methodology of Miot [19].[9].

$$n = \frac{(Z\alpha/2.\sigma)2}{E}$$

Where:

n- Number of individuals in the sample;

$Z\alpha/2$- Critical value corresponding to the degree of confidence;

σ- Population standard deviation of the variable studied;

E- Margin of error or maximum estimation error.

2.3. Evaluation of good manufacturing practices

The hygiene and health conditions of establishments selling chicken cuts were assessed using a survey comprising 54 items to check good manufacturing practices. The items evaluated covered (i) building; (ii) facilities, equipment, furniture and utensils; (iii) sanitization of facilities, equipment, furniture and utensils; (iv) integrated control of vectors and urban pests; (v) water supply; (vi) waste management; (vii) handlers; (viii) raw materials and packaging; (ix) conservation; (x) meat display; and (xi) documentation and registration.

Filling in the survey form was based on: (i) YES for "Compliant" (C) when the establishments fulfill the items observed; (ii) NO for "Non-compliant" (NC) when the establishments do not fulfill the items observed; and (iii) "Not Applicable" (NA) when the items are not relevant to the site under study.

2.4. Building, facilities, equipment, furniture and utensils

The assessment of this requirement went on to check the *layout of* the establishments in terms of access to internal areas (floors, ceilings, walls and partitions, doors and windows, sanitation and hygiene facilities, washbasins, lighting, and air conditioning). To this end, the equipment used to handle meat was also assessed, correlating with its state of repair and operation.

2.5. Sanitizing facilities, equipment, furniture and utensils

The sanitization of facilities, equipment, furniture, and utensils in commercial establishments selling chicken cuts was assessed in the context of safety. It assessed issues such as using sanitizers following the manufacturer's specifications, compliance with Ministry of Health regulations, and having a qualified person in charge of hygiene.

2.6. Integrated vector and urban pest control

The existence of barriers to protect against the entry of vectors and pests and a set of effective and continuous actions to control them were checked.

2.7. Water supply

The existence of a drinking water supply was checked to determine whether drinking water was used for handling meat, sanitizing facilities, equipment, furniture, and utensils.

2.8. Waste management

The existence and availability of correctly identified solid and liquid waste collectors in the meat marketing and storage areas were checked, as was the frequency with which this waste was collected and stored in a closed area isolated from the meat marketing and storage area.

2.9. Raw materials and packaging

The conditions of transport and conservation of raw materials, quality, temperature control of raw materials that require special conservation conditions, and the post-action verification of the shelf life of products were checked.

2.10. Conservation

The storage conditions of the meat were checked in terms of protection against contaminants and identification during the waiting period for transport, identification based on product designation, control of the binomial time together, and the type of batch.

2.11. Meat display

Meat display conditions were assessed in terms of the organization of the marketing area, the availability of suitable utensils and equipment, and the adoption of procedures to minimize the risk of meat contamination.

2.11. Manipulators

Meat handlers were assessed based on their profile (changing rooms, hygiene habits, state of health, health monitoring program, clipped fingernails) and how they handled personal protective equipment.

2.13. Documentation and registration

The existence of good practice manuals and standardized operating procedures in establishments selling chicken cuts was checked.

2.14. Analyzing data

The data was organized in *Microsoft Office* Excel® 365 *software* and assessed for compliance with **RDC No. 216/04 criteria**, according to Ref. [10]. Descriptive analysis processed the data, compiling relative and absolute frequencies to create graphs. Expression 2 was used to classify establishments in terms of compliance with the requirements of Good Manufacturing Practices.

$$PA = \frac{Ia}{Iav}\,100(\%)$$

Where:
PA- Percentage of adequacy;
Items met (Ia) - number of YES/NO answers;
Items evaluated (Iva) - total number of answers (YES/NO).

3. RESULT AND DISCUSSION

3.1. Building, installations, equipment, furniture, and utensils

The building, installations, equipment, furniture and utensils items (Figure 1) were compliant in all the commercial establishments. The highest levels of compliance (100%) were observed in (27.27%) of the establishments, followed by establishment A with 91.67%. Compliance of 75% was observed in (27.27%) of the establishments, while 66.7% was observed in (18.18%). According to the established criteria, non-conformities were observed in (72.72%) of the establishments assessed, with percentages ranging from 8.3 to 33.3%. Non-applicable conditions were observed in (18.18%) of establishments with a suitability index of around 16.7 to 41.7%. These observations are possibly associated with the precarious conditions of the buildings and the poor conservation of the physical installations. In some commercial establishments, the stacking of utensils in the working environment and the lack of maintenance and calibration of measuring instruments were noted.

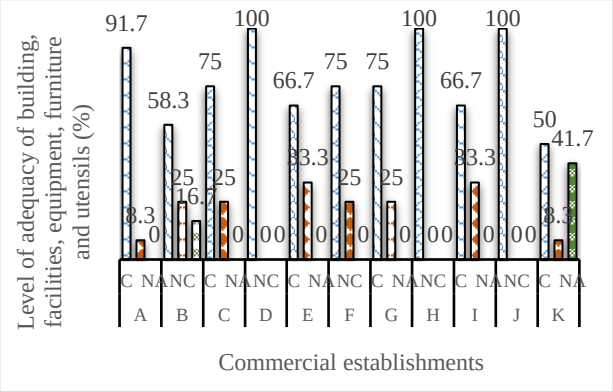

Figure 1. Levels of compliance of buildings, facilities, equipment, furniture, and utensils in commercial establishments selling chicken cuts. Source: (Authors).

In the study by Ref. [11] seeking to verify the implementation of good manufacturing practices in a supermarket in Palmas-TO, he obtained a percentage (58.22%) of compliance for buildings and facilities and 41.77% of non-compliance. Regarding equipment, furniture, and utensils, it reported compliance of around 57.14% and 42.85% non-compliance, which aligns with this study's.

In the assessment carried out by Ref. [12] when he researched the hygiene and sanitary conditions of food retail establishments in the Metropolitan Region of Recife - PE, he observed that for the item buildings, facilities, equipment, furniture, and utensils of supermarkets, the highest levels of adequacy were found in two establishments, ranging from 53.84 to 69.23%. The lowest rates were observed in six supermarkets, with a percentage between 15.38 and 30.76%.

Ref. [13], in their study on evaluating and proposing the suitability of meat retailers in Rio Pomba-MG, found 50% compliance, 42% non-compliance, and 8% non-applicable conditions in the physical infrastructure block. In the second block, there was 71% compliance and 29% non-compliance; in the third block, 44% compliance, 41% non-compliance, and 15% non-applicable conditions.

Diverging results from those found in this study were reported by Ref. [14], who, in their research entitled Evaluation and diagnosis of the hygiene and health conditions of a butcher's shop in Patos de Minas-MG, reported 43.59% compliance, 48.72% non-conformity and 7.69% non-applicable conditions for the building and facilities item. For equipment, furniture, and utensils, 61.90 % were adequate, and 38.10 % were inadequate.

3.2. Sanitizing facilities, equipment, furniture and utensils

The sanitization of facilities, equipment, furniture, and utensils showed that the percentage of compliance ranged from 50% to 100% (Figure 2), and all the establishments assessed complied. The highest compliance results were observed in establishments H (83.3%) and D (100%). It was observed that (63.63%) of the establishments were 66.7% compliant.

Non-compliant requirements were observed in percentages ranging from 16.7 to 50%, with the highest rate being observed in establishments C and F at around 50 %, followed by 36.36% of establishments with an inadequacy rate of 33.3% and an inadequacy rate of 16.7% observed in 27.27% of establishments. Results for non-applicable items were observed in (18.18%) of the establishments, with a percentage of 16.7%. These findings

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may be linked to the inefficiency of the buildings' facilities, deficient hygiene conditions, and the lack of an agent responsible for monitoring hygiene.

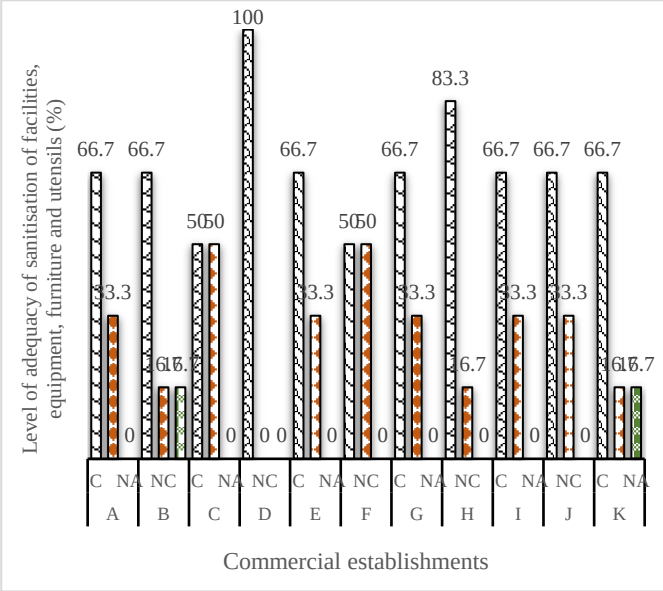

Figure 2. Adequacy index for sanitizing facilities, equipment, furniture, and utensils.
Source: (Authors).

Similar values to those of the present study were described by Ref. [10] when evaluating good practices in a supermarket in Cariri, Ceará, with 50% inadequate hygiene of the premises and 75% inadequate hygiene of equipment, machinery, and utensils.

In Ref. [15] assessment of hygiene and sanitary quality, he obtained 76.47% adequacy and 23.53% inadequacy. A lower rate of non-compliance was found by Ref. [20] when assessing the hygienic-sanitary and microbiological conditions of meat in butchers' shops, with 8%.

3.3. Integrated vector and urban pest control

The results of the integrated control of vectors and urban pests in establishments selling chicken cuts (Figure 3) showed that all the establishments assessed were compliant (100%). No non-conformities or non-applicable items were observed in this area. These results are possibly justified by actions implemented to control vectors and urban pests to prevent their attraction, harbouring, access, and proliferation.

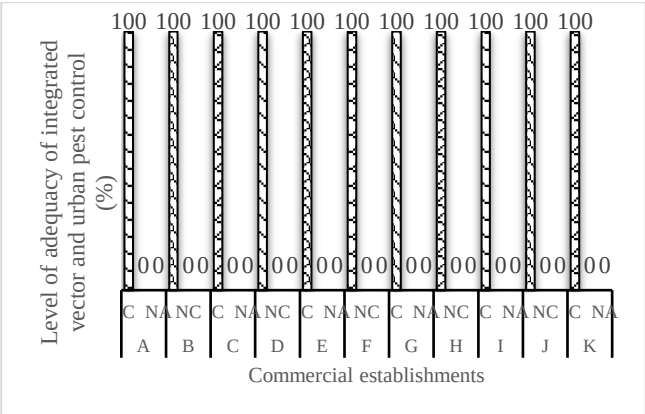

Figure 3. Compliance with integrated vector and urban pest control in establishments selling chicken cuts.
Source: (Authors).

Ref. [16] reported (100%) compliance in their study on the hygiene and health aspects of commercial establishments, which aligns with the results obtained in this study.

Similar results were reported by Ref.[17], 100%, when carrying out his study on the hygienic-sanitary and microbiological conditions of fresh carcasses in butcher's shops, and by Ref. [14], in his research on the implementation of a quality system in a butcher's shop in the city of João Pessoa - PB, he obtained 100% compliance.

3.4. Water supply

Concerning water supply, all the establishments assessed were found to comply. 100% of the establishments were found to be compliant. No non-conformities or non-applicable conditions were observed. These results are justified by using drinking water from the public network.

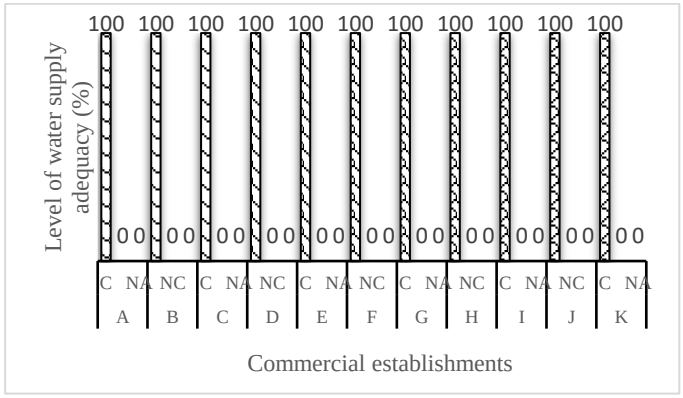

Figure 4. Adequate water supply.
Source: (Authors).

Similar results to those of this study were observed by Ref. [17] when he assessed the hygiene and sanitation conditions of the water supply, obtaining 100% adequacy, results similar to those of this study.

Lower results were reported by Ref. [18] when he assessed the hygiene conditions of meat in open-air fairs and markets in the municipality of Belém-PA, with an adequacy percentage for the water supply of 33%, non-compliant 21%, and non-applicable items 46%. These results are because many establishments do not have their water supply, and many of the markets use buckets of water taken from the toilet for sanitization.

Lower results than those obtained in the present study (100%) were reported by Ref. 10] in their research on the evaluation of good practices in a supermarket in the Cariri region of Ceará, who observed 54.54% adequacy and 45.46% inadequacy.

Ref. [19], in their research into the hygiene and health conditions of meat shops in Aracati-Ceará, reported 77.77% compliance and 22.22% non-compliance with the water supply item.

3.5. Waste management

Regarding waste management, the results showed that the establishments selling chicken cuts were compliant, with the percentage of compliance ranging from 33.3 to 100% (figure 5). The highest level of 100% compliance was observed in 36.36% of the establishments. The lowest suitability index values (33.3%) were observed in (54.54%) of the establishments. It was found that (63.63%) of the establishments presented situations of non-conformity, with a percentage ranging from 33.3 to 66.7%.

Situations of non-applicable conditions were evident in establishment I with 33.3%.

The non-conformities and non-applicable conditions observed in waste management are due to waste piled up around the establishments and the lack of waste collectors.

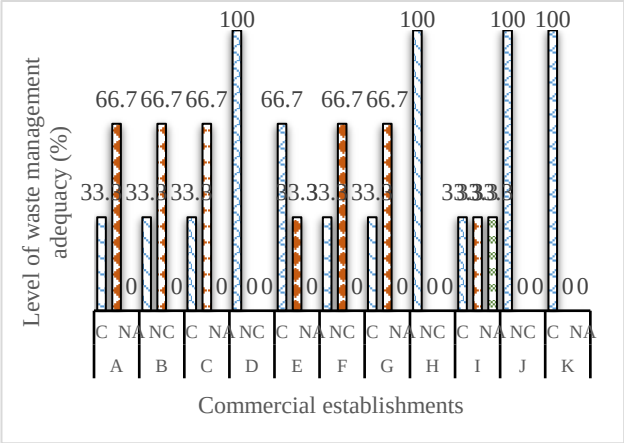

Figure 5: Waste management compliance of chicken cut shops. Source: (Authors).

Ref. [10] When assessing good practices in a supermarket in the Cariri region of Ceará, 66.67% inadequacy. Ref. [20], in their research on the assessment of hygiene and sanitary conditions, found a percentage of non-compliance of around 78.6 to 82.4% in the establishments assessed. This was due to the absence of Good Manufacturing Practices (GMP) and a predictive and corrective waste removal assessment.

Ref. [17], in his study on the assessment of hygienic-sanitary and microbiological conditions, reported a compliance rate of 100%, because they maintained adequate separation with proper identification.

3.6. *Manipulators*

The results of this requirement showed that the establishments assessed were compliant (Figure 6) with percentages ranging from 50% to 100%. The highest level of compliance (100%) was seen in establishment H, followed by 83.3% compliance in 36.36%. Non-conformities were found in 72.72%, with the highest rate of non-conformity (50%) observed in establishments F and G. Non-applicable items were found in 27.27% of establishments, ranging from 16.7 to 33.3%. The non-conformities and non-applicable items are possibly associated with the inadequate presentation and personal hygiene of the handlers and the low level of sanitization before and after handling the meat.

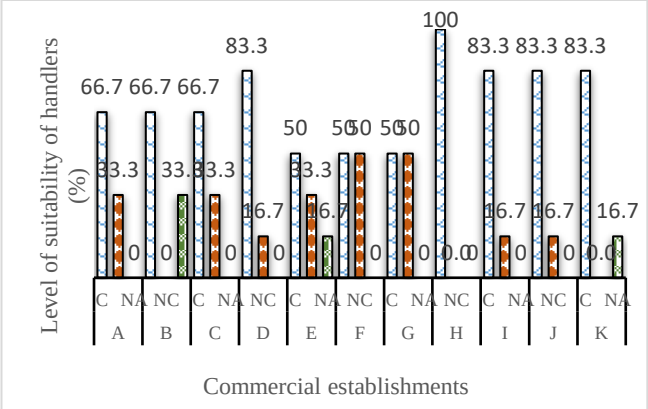

Figure 6: Compliance levels of the establishments' handlers. Source: (Authors).

Ref. [21] evaluated the hygiene and sanitary conditions of a meat products factory in Jaraguá do Sul, Santa Catarina, and found 63.6% compliance and 36.4% non-compliance, similar to this study's results.

Diverging results from those of the present study were reported by Ref. [22] when evaluating the hygiene and sanitary conditions of butchers in a free market in the municipality of Mamanguape, Paraíba, obtaining compliance in the range of 20 to 45%, non-compliance of 45 to 70% and conditions that do not apply 10 to 14%. In the study carried out by Ref. [23] to assess the hygiene and sanitary conditions in the commercialization of meat in public markets in the cities of Limoeiro and Vitória de Santo Antão - PE, he obtained 100% non-compliance (57.14%) units.

Ref.[24] reported in his study entitled Evaluation of hygienic and Sanitary Conditions, that in the block referring to handlers he obtained 85.71% non-compliance and 14.29% compliance. Ref. [25] verified the implementation of good manufacturing practices (GMP) in a supermarket in Palmas-TO, obtained a percentage of 71.42% compliance and 28.57% non-compliance. This result was due to the absence of personal protective equipment.

3.7. *Raw materials and packaging*

Regarding raw materials and packaging, all establishments complied with percentages ranging from 20 to 100%. The highest compliance (100%) was seen in establishments D and J, followed by 80% in establishments F and G. On the other hand, 36.36% of the establishments were around 60% compliant. Non-conformities were found in 72.72% of the establishments assessed. Inapplicable conditions were observed in (36.36%) of the establishments assessed, with a percentage ranging from 20 to 80%, with the highest percentage of inapplicability being 80%.

The non-conformities observed in this item are associated with the lack of criteria for evaluating and selecting suppliers, the lack of verification of the conditions in which food products are transported, the lack of verification of expiry dates and the lack of adequate packaging.

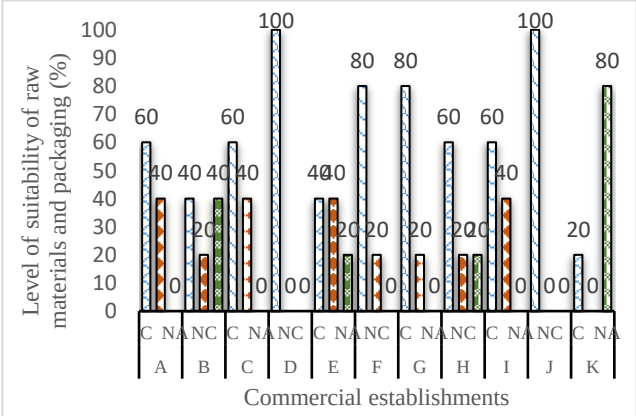

Figure 7. Levels of raw materials and packaging suitability in establishments. Source: (Authors).

Ref. [14], when assessing and diagnosing the hygiene and health conditions of a butcher's shop in Patos de Minas, reported 33.34% of compliant items, 60.60% of non-compliant requirements, and 6.06% not applicable.

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Research by Ref. [26] on the assessment of hygiene and sanitary conditions obtained 91.7% compliance; lower results were observed in 81.81% of the establishments assessed in this study.

3.8. Conservation

The results obtained for the conservation item (Figure 8) indicated compliance in all establishments. The highest level of compliance (100%) was observed in 36.36% of the establishments, 80% compliance was observed in (27.27%) of the establishments, and (36.36%) of the establishments showed compliance of around 60%. Non-compliance was found in (54.54%) of the establishments, with percentages varying between 20 and 40%.

Non-applicable conditions were observed in (18.18%) of the establishments. Results of non-conformity and non-applicable conditions are related to inadequate conservation conditions.

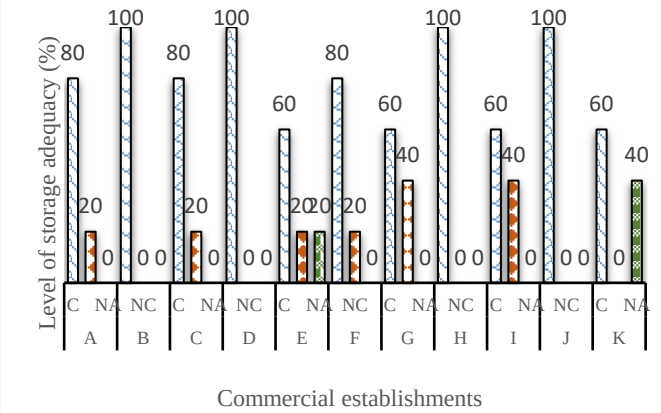

Figure 8. Conservation of chicken cuts shops.
Source: (Authors).

A study carried out by Ref. [27] on the evaluation of the strategic plan for the implementation of good food manufacturing practices found 100% compliance, while similar results were obtained in 36.36% of the establishments in this survey.

Values higher than those found in this study were described by Ref. [28], in their research on the adequacy of food services to good manufacturing practices, obtained 53.6% compliance, by Ref. [**21**], regarding the storage of meat, the boxes evaluated showed non-compliance, with 75%, 90% and 100% in their research evaluating the hygienic-sanitary conditions of butchers at a free market, and by Ref. [23], when assessing hygienic-sanitary conditions in the commercialization of meat in public markets in the cities of Limoeiro and Vitória de Santo Antão, obtained 50% non-compliance.

3.9. Meat display

Concerning the display of meat, all establishments were compliant. The highest levels of compliance (100%) were observed in 27.27% of the establishments. On the other hand, non-applicable items were observed in 45.45% of the establishments, with percentages ranging from 11.1 to 33.3%. The non-conformities observed in this item are possibly linked to the inadequate organization of the display area, the lack of adequate utensils and equipment, and the failure to adopt procedures to minimize the risk of meat contamination.

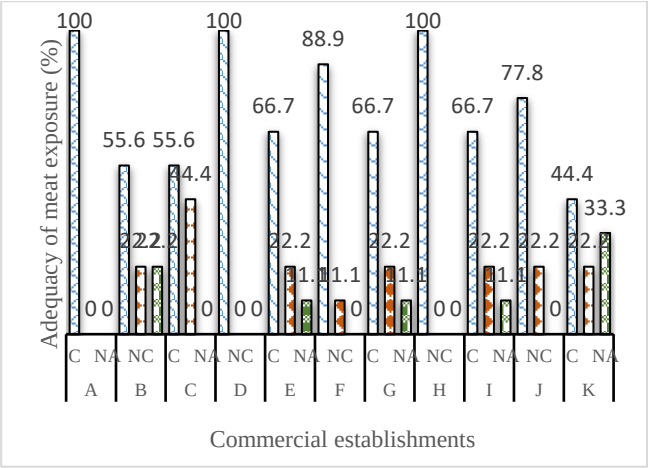

Figure 9. Percentage of compliance of the establishments' meat display.
Source: (Authors).

When Ref. [29] Paula and Lacerda (2016) conducted a hygiene and health assessment of meat sales in supermarkets, they found 75% compliance and 25% non-compliance.

A study carried out by Ref. [30] Barros and Silva (2016) evaluating good hygiene practices in commercial establishments found percentages of compliance of around (100%) in 50% of the establishments evaluated, and similar results were obtained in this study in (27.27%) of the establishments.

Aquino and De Castro [5] [31] evaluated the hygiene and sanitary conditions in Patos Minas and found that exposure was 100% adequate, similar to this study's results. Ferreira *et al*. [10][23], when evaluating the hygiene and sanitary conditions of commercial establishments in a town in the south of Minas Gerais, reported 65% compliance and 35% non-compliance, similar results to those of this study.

3.10. Documentation and registration

The documentation and registration items showed that the establishments were not compliant. Non-compliance rates (100%) were observed in 81.81% of the establishments. Non-applicable conditions were observed in (18.18%) of the establishments. These results show the absence or lack of Good Manufacturing Practices (GMP) manuals and Standard Operating Procedures (SOPs) in commercial chicken-cut establishments.

In the study by Ref.[17], when assessing the hygienic, sanitary, and microbiological conditions of meat in butcher's shops, 100% non-compliance was obtained, similar to those of this study.

Ref. [32], in their study on the assessment of hygienic and sanitary conditions, obtained 100% compliance. The establishments assessed had Good Manufacturing Practice (GMP) manuals and Standard Operating Procedures (SOPs).

Ref. [14], in their study on the assessment and diagnosis of the hygiene and sanitary conditions of a butcher's shop, found 52.94% of non-conformities and 47.05% of conformities.

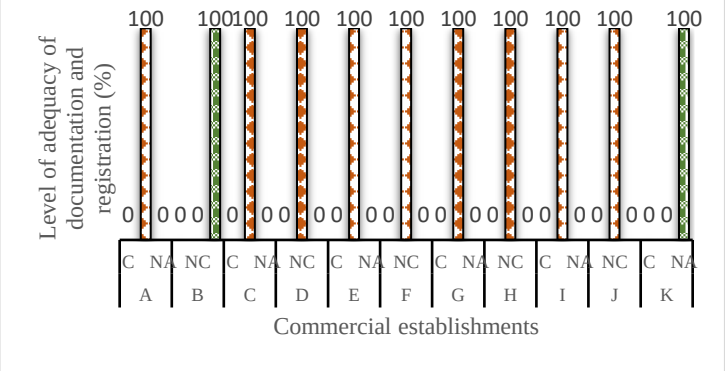

Figure 10. Compliance with documentation and registration of commercial establishments selling chicken cuts. Source: (Authors).

4. CONCLUSION

Based on the results presented in this study, there was sufficient evidence that the commercial establishments selling chicken cuts in Chókwè city carry out hygiene and sanitization procedures to integrate control of vectors and urban pests; water supply; waste management; conservation, and the display of meat in compliance with good manufacturing and hygienic-sanitary practices in commercial establishments selling chicken cuts. 100% of commercial establishments do not have manuals on good manufacturing practices and standardized operating procedures.

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