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Comparative Bacteriological Evaluation of Ready-To-Eat Snacks Marketed in the Vicinity of University of Maiduguri Student Campus

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Abstract: *The popularity of ready-to-eat (RTE) foods consumption has increased globally, especially among students in the institutions of higher learning, because RTE readily available, convenient, tasty, and have attractive packaging designs. However, RTE foods can be easily contaminated with pathogenic bacteria during the production or packaging process. Thus, there is a need for routine assessment of such food to ensure quality life among students on campus. In this study, meat-pie samples were purchased from five different sellers in the vicinity of UNIMAID. The samples were analyzed to determine bacteriological indices while the different bacterial isolates were inoculated and incubated overnight in different biochemical medium for further characterization. The sample A had a total heterotrophic count of 3.64 Log CFU/g, the sample B had 3.70 Log CFU/g, sample C had 3.40 Log CFU/g, sample D had 4.0 Log CFU/g and sample E had 3.2 and 4.4 Log CFU/g. The bacteria isolated identified in this study include Streptococcus sp., Escherichia coli, Klebsiella, sp. Bacillus, sp., Pseudomonas sp., Proteus sp. And Bacillus sp. The presence of Streptococci and other fecal suggest that possible sources of the contamination could be associated with poor personal hygiene during the production packaging processes. Based on the implication of the results of this study there is a need for creating awaness among the students and staff in the study area on the possible danger of consuming the meat pie withing the campus.*

Keywords: *Bacteria, Meat-Pie, Bacteriological Indices, Bio-Chemical Test.*

Introduction

The popularity of ready-to-eat (RTE) foods has increased globally, especially among students, because they are readily available, convenient, tasty, and have attractive packaging designs. The number of packaged foods, drinks, and snacks has risen in the Indian market, and the presence of less-healthy packaged products is a significant cause of overweight and diseases related to diet. The Health Star Rating (HSR) System, initiated by the Australian and New Zealand governments, was designed to rank these packaged products based on fat, sugar, energy, salt, and other nutritional compositions. The study assessed the nutritional value of RTE snacks currently available in the Indian e-market using the HSR system Gilbert *et al*. (2000).

Ready-to-eat foods are normally taken by a diverse number of people outside their daily meals. This has been perceived to conveniently substitute home-made food, and time to make these foods may be a burden. Retailed foods and snacks have become one of the oldest vehicles for most daring food-borne illnesses (Walker *et al*., 2003; Birgen *et al*., 2020). Poor food processing and handling have been identified as a common pathway for enteropathogens in most ready-to-eat foods made on a cottage scale (Mensah et al. 2002). Poor packaging of ready-to-eat foods also have been implicated in the cross- contamination of most these foods. This is because the sanitary quality of most quality packing materials like newspaper, leaves, polyethene bags etc have been implicated as well.

Gizaw (2019) reported life-threatening food-borne pathogens involved in producing toxins that are responsible for poisoning and foodborne ranging from *Salmonella* to *Vibrio* in some RTE foods. Foodborne diseases outbreak in China between 2003-2017 reported 19 517 food-borne fatalities with cases of 235 754 illnesses, 107, 470 hospitalizations, and 1457 deaths; Over13,000 were caused by enteric and non-enteric pathogens like *Salmonella* sp. and *Bacillus cereus*, respectively (Li *et al*., 2020). Food handling process play a crucial role in food safety the downline processing of the food. Poor handling and unhygienic practices by food vendors introduce several pathogens into foods and this may result in most hospitalization and even death (Greig et al., 2007; Todd et al., 2007). They also have been implicated in the spread of these disease-causing pathogens due to their inability to follow a strict and laid-down process for the workplace for which some of the pathogens may be associated or normal flora of a number of the parts of the body and can be transferred from one to another in the cases of abuse of sanitary instruction in hazard components and this goes to compromise the safety of process chain (Akonor and Akonor, 2013).

Snacks made from poultry products are potentially hazardous RTE foods as they habour a number of pathogens that may be involved in food poisoning and they can support the growth of other pathogens. Most of these foods are prone to deterioration and can harbour a diverse group of microbes. Mensah *et al*. (2020) reported the presence of *Bacillus cereus*, *Staphylococcus aureus*, *Shigella sonnei*, *Escherichia coli*, and *Salmonella arizona* on RTE foods retailed in Ghana. Nyenje *et al*. (2012) reported the microflora of RTE in South Africa and identified a wide array of microbes that are involved in gastroenteritis. Hygiene practices and workplace sanitary conditions have been identified to impact on the food handlers this is evident in the bacterial counts. Levels of *Staphylococcus aureus*, coliforms, *Clostridium perfringens*, and *Bacillus* cereus are mainly associated with foodborne diseases (Bintsis, 2017). *Escherichia coli* primary indicator of pathogens of sanitary conditions and representative of gastroenteritis and their variants are harmful to man (Osakue *et al*., 2016). The spate of *Staphylococcal* food-borne diseases in raw foods can result in debilitation of the health of immunocompromised persons that may come in contact with the food (Osakue *et al*., 2016).

Materials and Methods

Four potato based meat pie samples were randomly purchased from four different sellers within the University of Maiduguri Campus. The samples were bought to the Microbiology Laboratory University of Maiduguri for bacteriological assessment. 60g of each of the samples were pulverized to homogenize using a sterile mortar and pestle, and then 6g of the pulverized samples were transferred into a sterile test tube and serially diluted using 10-fold sterile physiological saline. Then, an aliquot of about 0.1 ml was aspirated and used for the plating

Isolation and identification of the microbes

All the four samples were evaluated for total heterotrophic count and coliform were performed to ascertain the microbial load of the samples (Cheesebrough, 2006). Bacterial isolates were sub-cultured for 18 hr. to avoid Gram reversion.

Microbial evaluation of ready-to-eat snacks

The total heterotrophic count of the ready-to-eat snacks obtained from Hezekiah University is presented in Figure 1. The African breadfruit had a total heterotrophic count of 3.64 Log CFU/g, the sample B had 3.70 Log CFU/g, sample C had 3.40 Log CFU/g, sample D had 4.0 Log CFU/g and sample E had 3.2 and 4.4 Log CFU/g. Statistical Analysis using 2-way ANOVA at p- value < 0.05 showed a significant difference between the microbial populations in the ready-to-eat meat pie marketed within University of Maiduguri, Nigeria.

Biochemical identification of the bacterial isolates

The biochemical attributes of the isolates are presented in Table 2 above, the Isolate BF1 was obtained from the breadfruit and was picked based on its colonial morphology, the gram reaction revealed the organism was Gram Positive, the catalase and oxidase test were positive, the TSI results showed it had an acidic slant. The organisms also showed as being a non-lactose fermenter for sugar fermentation. The tests for maltose, xylose, and sucrose were all negative, while tests such as citrate and starch hydrolysis were all positive. The isolate BF1 was identified to be *Staphylococcus* sp. The second isolate obtained from the African Breadfruit was identified as *Klebsiella* sp., the isolate was a Gram Negative showing the signs of being both Catalase and Oxidase positive, and its reaction.

Table 1: Statistical analytical results of aerobic plate count in the meat pie sample

Meat pie sample	Aerobic count (cfu/g)		
	Minimum	**Maximum**	**Mean**
A	2×10^2	3×10^8	3.6×10^5
B	1×10^3	4×10^6	3.7×10^5
C	3×10^2	3×10^7	3.4×10^5
D	5×10^3	4 x 106	4.0×10^5

Table 2: Biochemical Identification of the Isolates obtained the ready-to-eat food

Biochemical	**A**	**B**	**C**	**D**
Gram Reaction	+	-	-	-
Oxidase	+	+	+	+
Catalase	+	+	+	+
Citrate	+	+	+	+
Motility	-	-	-	+
Tentative Identity	*Staphylococcus* sp.	*Klebsiella* sp.	*Pseudomonas* sp.	*Proteus* sp.

- = Negative, += Positive;

Discussion of Findings

The popularity of ready-to-eat (RTE) foods consumption has increased globally, especially among students in the institutions of higher learning, because RTE readily available, convenient, tasty, and have attractive packaging designs. However, RTE foods can be easily contaminated with pathogenic bacteria during the production or packaging process. Thus, there is a need for routine assessment of such food to ensure quality life among students on campus. In this study, meat-pie samples were purchased from five different sellers in the vicinity of UNIMAID.

The result of this study revealed that sample D showed contained the highest bacterial load according to total bacterial count, these count samples were higher than those obtained by Ahmed (1991), Hamid et al., (2008) who recorded that the total bacterial count in meat pie was 3.6 x 10^5cfu/g, but the results were lower than those obtained by El-Khateib et. al., (1988) who recorded atotal bacterial count of 107/g for chicken products and 6.6 x $10^5$for burger. Al-Dughaym et. al., (2003) revealed that the mean total bacterial count was 3.3x107 cfu/g for burger. Aerobic plate count in yoghurt also higher than the count (9.5x103 cfu/g) recorded by Khalaf and Shareef (1985). WHO (2000) stated that the total aerobic bacterial count was the most reliable method for detection of sanitary processing or proper storage of ready-to-eat products.

Conclusion

Snacking has become an unavoidable activity designed to provide immediate energy needed for work as an alternative to a proper meal. The hygiene of the food process might be overlooked in cases of extreme hunger or starvation. The university space is mostly inundated with a variety of these snacks which might due be contaminated.

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