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Review
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PRODUCTION, NUTRITIONAL QUALITY AND MICROBIAL SAFETY OF SELECTED NIGERIAN DRIED MEAT PRODUCTS: A REVIEW

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Abstract: Production and consumption of dried meat products are increasing considerably across all nations because they are nutritious, low in fat, easily accessible, and convenient for customers to eat. Over the years, its roles have become vital in human diet as they are consumed to combat protein malnutrition and boost food security of undernourished people in underdeveloped and developing nations. Initially, dried meat products are made to satisfy consumer expectations for sensory and nutritional attributes as well as to reduce meat wastage and increase the meat shelf life during prolonged transportation and storage. Recently, the discovery of contamination that is above the minimal threshold advised for meat safety has made the safety of dried meat products the focus of microbiological evaluation. It is well recognized that eating meat products with poisoning microorganisms could put customers at risk for health problems. As a result, it is critical to refocus the research to determine the viability of dried meat products for eating after production by evaluating the production processes, nutritional quality, and microbial safety. Therefore, this review aimed to highlight the production procedures, nutritional quality and microbial safety of dried meat products and their suitability for consumption after production.

Keywords: Dried meat products, Mycotoxin, Microbial safety, Kilishi meat, Tinko meat

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1. Introduction

Traditional dried meat is one of the most important meat products that reflect the culture, heritage and identity of people across the world (Karabasil et al., 2018) because they are usually produced using ingredients and procedures from ancient times. Frequently, traditional meats are prepared to satisfy the expectations of consumers (regarding sensory, nutritional aspects and safety), reduce meat wastage and combat protein malnutrition (protein deficiency) and boost food security in the nation (Laranjo et al., 2017). They are usually produced from high quality and carefully selected raw meat and produced and consumed as rich source of protein and other essential nutrients such as minerals, vitamins and amino acids.

Dried meats are products made from the muscle or carcass of animal which have been subjected to dehydration by thermal treatment in order to enhance taste and extend shelf life during transportation and storage (Mediani et al., 2022). Additionally, it refers to meat products whose moisture content has been dehydrated to a level below 25% with expression of water activity ranging between 0.00 and 0.60 (Mishra et al., 2017). The low moisture content of dried meat guarantees longer shelf life because of the low water activity which inhibits microbial growth (Eke et al., 2013).

The most common dried meat products in Nigeria include kilishi, tinko, catfish etc. In other countries, different varieties of dried meat products such as biltong (South Africa) pastirma (Turkey), bundner fleisch (Switzerland), beef jerky (USA), rougan and shafu (PR China) etc. have been developed (Mediani et al., 2022; Sivaranjani et al., 2022). Dried meat and meat products may play a major role in providing protein-rich food to under nourished people in underdeveloped and developing nations. These products are of much interest since they do not require refrigeration during marketing as well as storage. Until recently, the consumption of dried meat products has been regarded as being safe because of the heat treatments that are usually involved during their processing and production (Ribah et al., 2020), which enabled preservation for a longer period of time without any sign of deterioration and off-flavor. However, the discovery of contaminants such as mycotoxins in dried meat products has created a public health concern around its consumption in recent times. Since there is an increase in demand and consumption of meat across the world, it is needed to highlight the production process, nutritional and safety quality of dried meat and factors that influence their production and consumption.

2. History and Consumption of Dried Meat Products

For thousands of years, countries all over the world have used different traditional processing methods such as sun drying and smoking to preserve and extend the shelf-life of meat and meat products. The idea of drying meat began with the necessity to reduce the moisture content and weight of meat as well as maintain nutritional content for longer periods as a source of protein for merchants and military officers traveling long distances. There is evidence that production of dried meat began in ancient times in Asia, North America, Africa, and Europe, while in South America, the drying of meat was reported to begin in year 1500's. However, statistics on the production and consumption of dried meat are scarce in Nigeria. It is known that dried meat products hold a large share in local meat production and consumption in Nigeria and across the world. In Nigeria, the consumption of dried meats (e.g kilishi meat) is common in the northern part of Nigeria, partly because of the abundance of cattle and camels for production and also due to intensity of sunlight (Akerele et al., 2010). In recent times, however, the consumption of dried meat product has gone beyond the borders of northern part of the country and become delicacies that cut across different ethnic groups, religion, social and economic class.

3. Types of Dried Meat in Nigeria

In Nigeria, several dried meat products have been developed over time with Banda or kundi or tinko (boiled and sundried meat), Balangu (smoked chunks of meat), Dambu-nama (spiced, cooked, pounded, shredded and dried meat) and Kilishi (sliced, coated and sundried meat) being the most prominent products majorly prepared in the Northern parts of the country (Muhammad et al., 2010; Ajiboye et al., 2011; Adeyeye et al., 2016). Others include Ndariko, Jiorge etc (Ajiboye et al., 2011) which are prepared from meats of donkeys, asses, horses, camel, buffalo and wild-life (Ajiboye et al., 2011). The production of the different types of meats is further discussed in the next sections.

4. Production of Kilishi Meat

Kilishi is a popular, traditionally processed ready-to-eat meat product usually produced in the northern part of Nigeria. The processed meat is originally made from fresh carcass of cattle but has now been extended to other ruminant and non-ruminant animals such as sheep, goat, pig and camel (Ayorinde, 2015). The production of kilishi involves four essential stages of technology that include meat preparation, infusion of ingredients/spices, application of heat and storage/packaging (Figure 1).

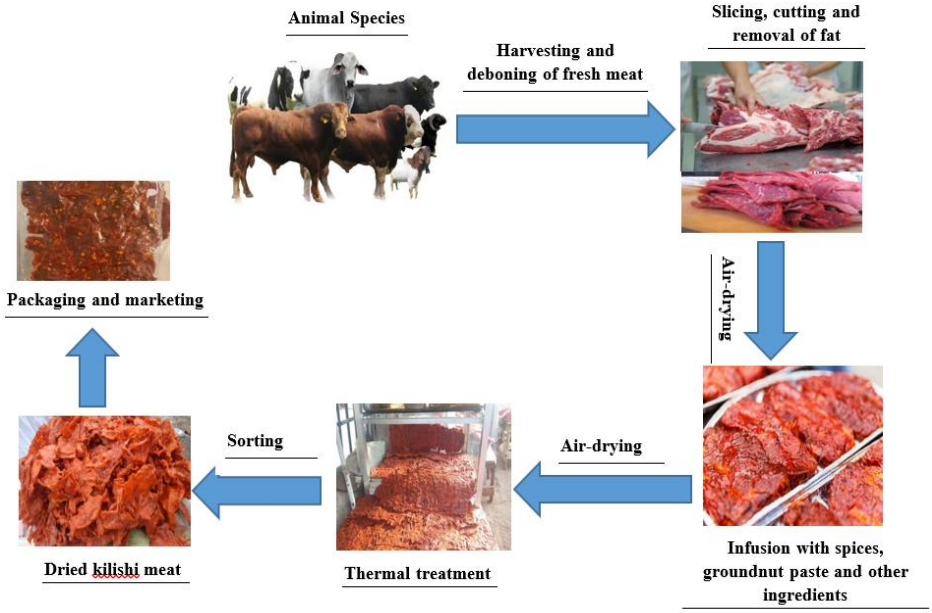

Figure 1. The stages in production process of Kilishi meat.

During meat preparation, it is important to select a fresh muscle especially the Longissimus or Semimembranosus muscles of the carcass, and thereafter clean, debone and trim of fat and excess connective tissues in order to obtain the lean meat. Thereafter, the lean meat is cut into small portions and each portion is sliced into a sheet of one meter or less to allow easy drying. The next stage is the preparation of ingredients for infusion. The key ingredient in the processing of Kilishi is the groundnut paste. The groundnut paste is normally obtained from dehulled roasted groundnut seeds after milling, kneading and extraction of oil (Ogunsola and Omojola, 2008). The groundnut pastes together with other ingredients such as spices (onion, pepper, ginger, thyme, cloves etc) salt and honey are mixed thoroughly with water to form a slurry. The meat sample will be marinated/soaked in the infusion slurry for an hour. After that the sample is removed and carefully spread out under the sun for drying for about 6 hours and then roasted in the oven to heat-seal the infused ingredients (Ogunsola and Omojola,

2008). Finally, the finished products can be cooled at room temperature, packed and heat sealed in high density polyethylene bags for preservation and storage (Iheagwara and Okonkwo, 2016).

4.1. Nutritional Quality of Kilishi Meat

Different meats have been shown to have potentially important nutritional differences. The proximate composition of the kilishi meat made from different species of livestock is presented in Table 1. Irrespective of species, it is evident that kilishi meat is characterized with high protein content which ranges between 57.00 and 71.00%, moderate fat content between 6.40 and 13.33 and ash content between 2.55 and 8.87% as well as low moisture/water content between 9.75 and 26.33%. However, Kilishi made from camel meat contained higher moisture (15.92-28.33) and protein (58.55-70.45) while those made from beef have the lowest moisture (9.75-14.10) and protein (57.02 – 64.40) contents. The variation in the levels of the various nutrients in kilishi meat within species could be as a result of differences in the carcass composition, age at slaughter, sex, technique of analysis and amount of groundnut cake paste used. In comparison to other meat products, kilishi meat contained higher protein content than raw beef, mutton, chevron, pork and camel meat which ranges from 16-23%. This is because the moisture content of kilishi meat has been significantly dehydrated by drying thereby improving and concentrating the percentage protein content and other nutrients in the meat. Reports have shown that cooking or heat processing usually decreases moisture content and concentrates other nutrients in meat products (Iheagwara and Okonkwo, 2016). In addition, the type and amount of slurry agents used may also influence the protein content of kilishi meat (Idowu et al., 2010; Iyiola et al., 2021). Previous research has shown that the addition of groundnut cake paste tend to increase or contribute to higher protein content of kilishi meat when compared to other meat products (Idowu et al., 2010).

Table 1. Proximate composition of Kilishi meat

Parameters (g/100g)	Beef	Camel	Chevron	Pork	Mutton
Moisture	9.75[a]- 14.10[b]	15.92[b]-28.33[h]	17.17[h] -26.27[h]	9.92[d]-26.33[h]	9.33[e]
Crude Protein	48.1[f]- 64.40[g]	58.55[h]-70.45[h]	57.91[h]- 69.18[h]	59.41[d]- 66.63[h]	38.68[e]
Crude Fibre	0.40[g]	-	2.83[e]	-	2.83[e]
Crude Fat	6.21[j] - 18.10[a]	6.40[b]	17.00[e]	13.33[d]	22.00[e]
Ash	7.10[a] - 8.87	5.12[h] - 5.79[h]	2.55[h]-7.88[h]	6.96[d] -7.55[h]	16.00[e]
Carbohydrate	2.30[g] - 8.05	-	28.78[e]	-	23.82[e]

e=Adeyi et al., 2015, a=Idowu et al., 2010, b= Ayorinde and Muhammad, 2017, d= Ogunsola and Omojola, 2008, f= Olusola et al., 2017, g= Adeyeye et al., 2020a h= Fakolade and Fatola, 2021, j=Iyiola et al 2021.

4.2. Mineral, Fatty Acids, Amino Acids and Vitamins Composition of Kilishi Meat

Mineral generally refers to the elements other than C, H, O, and N that are present in foods (Falowo, 2021). Minerals can occur in relatively low concentrations in foods but play key functional roles in both living systems and foods (Falowo, 2021). They can be classified as either major or trace elements. The major elements include calcium, phosphorus, magnesium, sodium, potassium, and chloride, while the trace elements are iron, iodine, zinc, selenium, chromium, copper, fluorine, lead, and tin. The mineral composition of kilishi meat is presented in Table 2. Like other meat products, the kilishi meats made from beef, camel, chevron and pork contain the relative amount of mineral elements. Kilishi beef possesses higher mineral elements with about 29.6mg/100g calcium, 81.6mg/100g magnesium, 320mg/100g sodium, 781mg/100g phosphorus, 985mg/100g potassium, 18.3mg/100g zinc, 8.62mg/100g iron, 0.05mg/100g selenium and 0.32mg/100g copper compared to kilishi made from camel, chevron and pork (Table 2). The substantial variation in the mineral composition of kilishi meats may be due to differences in species, nutrition and processing methods.

Previous research conducted on the fatty acid of Kilishi beef meat has showed that it contains higher unsaturated fatty acid than the saturated fatty acids (Table 2). The values of unsaturated fatty acids reported for kilishi are higher than those reported for fresh beef while the saturated fatty acids are less than those reported in fresh beef (Adeyeye et al., 2020b). There is a report that kilishi beef meat are very rich in unsaturated fatty acid compared to fresh meat. Unsaturated fatty acids are essential in the human diet for maintaining the impermeability barrier of the skin and are involved in cholesterol transport and metabolism (Adeyeye et al., 2020b). Also, the kilishi made for beef was reported to possess higher linoleic fatty acid than those made from camel meat (Ayorinde, 2015).

Previous research conducted on amino acids revealed that beef kilish is rich in essential and non-essential amino acid. On estimate, beef kilishi contains 38.2g/100g essential amino acid and 58.1g/100g non-essential amino acids. In addition, previous research conducted on vitamin content of kilish meat showed that they contained an appreciable quantity of vitamins (Table 2). The chevron and goat kilishi showed higher values of Vitamin D and Vitamin B12 than the beef kilishi. However, the quantity of vitamins reported in kilishi meat are relatively lower than those found in fresh meat. This decrease or reduction might be due to the

volatilization of the vitamin during thermal treatment. Prolonged thermal treatment has been shown to destroy fat-soluble vitamins and water-soluble vitamins, thereby making them volatile (Fakolade and Fatola, 2021).

Table 2. Mineral, fatty acids, amino acids and vitamins composition of kilishi meat

Parameters	Beef	Camel	Chevron	Pork
Minerals (mg/100g)				
Ca	29.6[g]	11.84[h]-12.39[h]	11.92[h]-12.59[h]	11.76[h]-12.19[h]
Mg	81.6[g]	15.85[j]-16.51[h]	15.99[h]-16.59[h]	14.73[h]-15.97[h]
Na	320 [g]			
P	781[g]			
K	985[g]	235[h]-251[h]	238[h]-258.67[h]	243[h]-246.00[h]
Fe	8.62[g]			
Zn	18.3[g]			
Se	0.05[g]			
Cu	0.32[g]			
Fatty Acid (%)				
Saturated fatty acid	33.4[j]			
Mono unsaturated fatty acid	41.2[j]			
Poly unsaturated fatty acid	25.4[j]			
Total unsaturated Fatty acid	66.6[j]			
Amino Acid (g/100g protein)				
Total essential amino acid	38.2[k]			
Total non-essential acid	52.1[k]			
Total amino acid	90.3[k]			
Vitamins (mg/100g)				
Vit A	1.94[g]			
Vit. B12	0.0013[g]	0.14[h]	0.11[h]	0.08[h]
Vit. B2	0.29[g]	0.005[h]	0.006[h]	0.001[h]
Vit. D	0.001[g]	0.79[h]	0.88[h]	0.73[h]
Vit C	6.53[g]			
Vit E	1.38[g]			

h= Fakolade and Fatola, 2021 g= Adeyeye et al., 2020a, j = Adeyeye et al., 2020b k= Adeyeye et al 2020c

5. Tinko Meat and Its Production Processes

Tinko is a Yoruba name that refers to traditional meat products made by sun-drying (Figure 2). In other tribes like Igbo and Hausa, the sun-dried meat product is called banda and Kundi, respectively (Adeyeye et al., 2016). Like kilishi meat, tinko meat is usually prepared from carcass of cattle and other transport animal such as donkeys, asses, horses, camel, buffalo as well as wild-life (Ajiboye et al., 2011). Nevertheless, Oladejo and Adebayo-Tayo, 2011 and Adeyeye et al (2016) in their study reported that tinko meat is made mostly from rejected cattle and discarded transport animals. Tinko meat is, however, widely consumed in Nigeria and other Africa countries. This is due to its readily availability, affordability and a prolonged shelf life (up 6–12 months under ambient temperature) after production (Adeyeye et al., 2016). Besides, tinko meat is consumed as a good source of animal protein to combat protein malnutrition in human diet (Oladejo and Adebayo-Tayo, 2011;

Adeyeye et al., 2016). The production of tinko meat involves five stages. This include collection of meat sample (animal carcass), cutting of the meat samples in cube shapes or small pieces, cooking of the meat sample for 15-30mins, drying and smoking for about 18-30hrs and lastly cooling, storage and packaging.

5.1. Nutritional Composition of Tinko Meat

The Nutritional composition of tinko meat is presented on Table 2. Meat is known to be rich in protein, lipid, carbohydrate, mineral and other nutrients. Precisely, it contains about 7.0 -12.6% moisture, 44.0 – 65.0% protein, 0.5 – 1.4% crude fibre, 1.2 – 24.5% ash and 10.0-14.0% carbohydrate contents (Oladejo and Adebayo-Tayo, 2011, Adeyeye et al., 2016, Table 2). In comparison, the range of protein, moisture, ash, crude fibre and carbohydrate content in tinko meat is similar to those of Kilish beef meat but higher than fresh meat. This indicates that processing methods do not have negative effects on the nutritional content of the meat especially if they are made from the same species of animal. Like kilishi meat and other meat products, tinko meat contains a relative amount of sodium (0.35-1.84%), calcium (1.24-6.76%), phosphorous (0.8-3.45%), magnesium (0.12-0.43%), potassium (0.09-0.53%), copper (1.5 -8.6 %), manganese (2.6-9.1%), zinc (120-449%) and iron (132-443%) among other nutrients (Oladejo and Adebayo-Tayo, 2011; Adeyeye et al., 2016, Table 3 and 4). However, there is little empirical research

on the amino acid, fatty acids and vitamins profiles as well as biosafety status of tinko meats. Further research should be conducted in order to provide more useful information about the complete nutritional content of tinko meat and its promise to meet the demands of consumers and the meat industry.

Figure 2. Image of Tinko meat.

Table 3. Proximate composition of Tinko meat

Parameters	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Ash (%)	Carbohydrate (%)
	7.48[a] - 12.63[b]	44.21[a] - 64.5[b]	3.17[a] - 12.27[b]	0.55[a] -1.37[b]	1.27[b] - 24.30	10.00[a]-14.00[a]

a=Oladejo and Adebayo-Tayo, 2011, b= Adeyeye et al., 2016.

Table 4. Mineral composition of Tinko meat

Minerals	Na	Ca	P	Mg	K	Cu	Mn	Zn	Fe
	0.35-1.84[a]	1.24-6.76[a]	0.8- 3.45[a]	0.12-0.43[a]	0.09-0.53[a]	1.5 –8.6[a]	2.6-9.1[a]	120- 449[a]	132- 443[a]

a=Oladejo and Adebayo-Tayo, 2011, b= Adeyeye et al., 2016.

6. Dambu-Nama and Balangu Meat Product

Dambu-nama is another nutritious dried meat product commonly produced in northern part of Nigeria. It is usually made from fresh meat obtained from carcasses of cattle, goat, sheep or camel meat (Figure 3). The meat is mostly preferred by consumers because of its soft and tender taste compared to the hard, non-soft kilishi product (Eke et al., 2012). Dambu-nama meat is reported to contain about 5.50 -7.60% moisture, 39.19-46.51% protein, 4.90-5.76% ash, 0.015- 0.72% crude fibre, 15.65-24.94% crude fat and 22.64- 26.54% carbohydrate (Eke et al., 2012). Reports on mineral concentration revealed that Dambu-nama meat contains about 1242.50-764.20 mg/kg sodium, 1112.20 - 1384.00 mg/kg potassium, 565.10 - 764.20 mg/kg potassium, 43.10-50.10 mg/kg calcium, 221.60-286.40 mg/kg magnesium and 128.73-181.73 mg/kg manganese (Eke et al., 2013). The production of Dambu-nama meat is said to involve the collection of fresh meat, trimming and removing of fat and connective tissues, cutting of the meat samples into nearly equal size, curing and mixing of the meat samples with seasonings and spices, cooking of the meat samples, pounding of the cooked meat into shredded structure, frying or oven drying of the meat to doneness and finally, cooling and packaging/marketing (Koleosho, 2013; Eke et al., 2013b). On the other hand, balangu refers to meat that has been grilled over wood or coal fire without the addition of seasoning in order to retain its natural flavor (Ribah et al., 2020). Like other traditional meat products, balangu is mainly produced in Northern part of Nigeria and other part of Africa. Its preparation includes collection of fresh boneless meat or offal/viscera from goat, sheep, camel and cattle, cutting of the meat sample into chucks, and grilling or roasting of the meat samples on a wire mesh over a smokeless or coal fire (Gambo et al., 2012; Ribah et al., 2020). Nutritionally, balangu meat products contain 62.70% moisture, 20.26% protein, 32.51% fat and 2.10% ash (Muhammad et al., 2010). Reports on mineral concentration revealed that balangu meat products contained 3.44 mg/g sodium, 8.38 mg/g potassium, 565.10 - 764.20 mg/kg phosphorus, 2.08mg/g calcium, 4.82mg/g magnesium, 1.30mg/g iron and 9.29mg/g zinc (Muhammad et al., 2010).

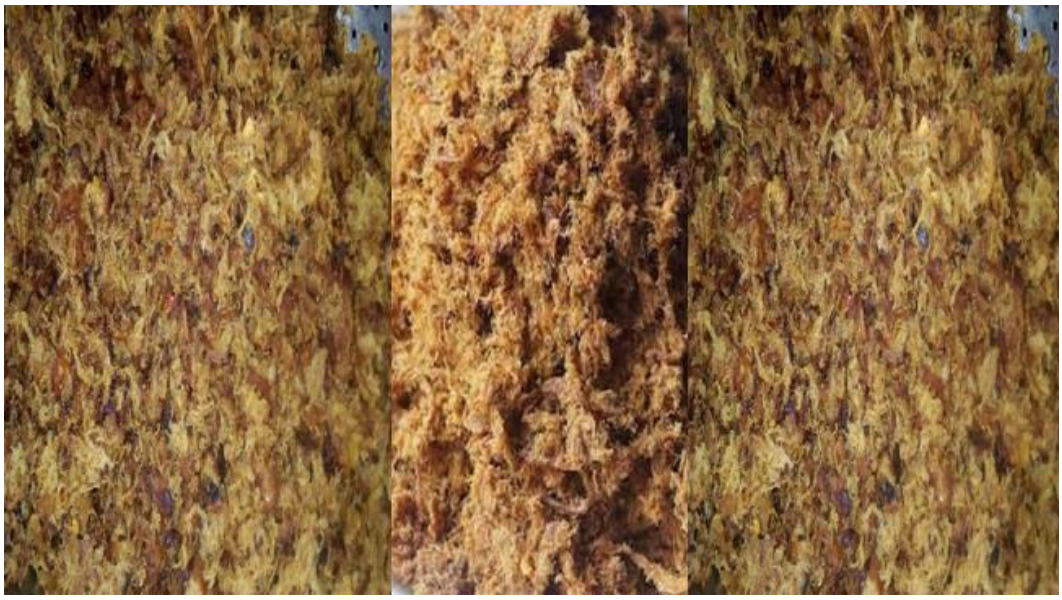

Figure 3. Image of Dambu-nama dried meat products.

7. Microbiology Safety of Dried Meat Products

Consumer awareness of the quality and safety of what they consume has increased in recent times. Microbial quality and safety of meat products are very important in ensuring consumer health and food security after production. Several research articles have emerged showing that the quality of meat and meat products could be compromised by spoilage organisms (bacteria, fungi, yeast and molds) especially during processing, handling, storage and marketing (Kovac et al., 2020, Anjorin et al., 2022). However, the production, handling and storage of Kilishi meat under a condition free of microbial contamination has been seen as a process usually difficult to achieve in Nigeria and Africa. This is because dry meat products, for instance kilishi meats are rich in nutrients which serve as a good culture medium for many micro-organisms (bacteria, yeasts and molds) to grow. The degree of spoilage is usually influenced by the concentration and availability of nutrients, presence of oxygen, storage temperature, pH at storage, initial microbial load at the beginning of production and the environment where the product is being processed etc. (Adeyeye et al 2020c; Iheagwara and Okonkwo, 2016). Different spoilage organisms such as Salmonella, E. coli, Staphylococcus and coliform bacteria (not microorganisms, mycotoxins are toxic compounds produced by certain types of fungi) that cause rapid deterioration and even poisoning have been identified and isolated from meat and meat products. These spoilage organisms could be introduced into meat by butchers and workmen, or through water and air in the dressing, cooling and cutting rooms or tables and even from the environment (Olusola et al., 2017). The consumption of these meat products, when contaminated with poisoning microorganisms, expose consumers to health threats and affects global trade. Nonetheless, the emerging results on evaluation of microbial safety of kilishi meat (using nutrient agar and isolation of organisms on a medium methods) has shown that the level of microbial counts in the meat products are below the recommended range of 5.4 - 8.0 log10, which is acceptable level of microbial load of ready-to-eat food products (Iyiola et al., 2021; Olusola et al., 2017). Recently, the use of analytical techniques such as High-Performance Liquid Chromatography (HPLC) method to detect the microbial load on food products showed that the kilish product may be unsafe for consumption especially when contaminated with fungi such as mycotoxins (Anjorin et al., 2022). Based on this, researchers are now advocating that the level of mycotoxins among other contaminants should be evaluated in food products because of their potential to cause cancer and suppress the immune system as well as decrease reproductive capacity and can cause allergies in consumers (EC 2006; Iqbal et al., 2014; Anjorin et al., 2022).

7.1. Occurrence, Detection and Prevention of Mycotoxins in Kilishi Meat

Mycotoxins are toxic secondary metabolites produced by various toxigenic species of fungi/mold that grow on meat products during storage. They can cause cancer and exert mutagenic effect when ingested by consumers of meat products (Montanha et al., 2018). There is evidence that about five billion people are constantly exposed to mycotoxins across the world (Khodaei et al., 2021, Pandey et al., 2023), thereby making it a public health concern around the world. On meat products, mycotoxins are produced by several species of fungi of the genus such as Aspergillus, Fusarium, Penicillium, Alternaria and Claviceps (Montanha et al., 2018). Among these species of fungi in meat products, Aflatoxins B1 (AFB1), B2 (AFB2), G1 (AFG1), and G2 (AFG2), Fumonisin B1 (FB1) , Ochratoxin A (OTA) and Ochratoxin A (OTB) (Anjorin et

al., 2022) are reportedly the most prominent. The level of AFB1 and total aflatoxins that have been recommended as permissible in food by European Union is estimated at 2µg/kg and 4µg/kg, respectively (EC 2010; Mahato et al., 2019; Dada et al., 2020). In Nigeria, Anjorin et al. (2022) in their study discovered that the consumption of kilishi meat from the central part of Nigeria could be unsafe because of the prevalence of Aflatoxin B1 and B2, OTA and OTB contamination levels recorded in their samples which were above the maximum limit reported by European Union (EU). Similarly, Oladejo et al (2011) in their study observed the high level of contamination of aflatoxins B1, B2, fumonisin (FB1 and FB2) and ochratoxin (OTA) in tinko meat sampled from the western part of Nigeria, which exceeded the maximum limit permitted in most countries by EU. In another study in South West of Nigeria, Dada et al. (2020) found that the concentration of aflatoxin in dried beef samples sold in the market greatly exceeded the EU (4 µg/kg) permissible level in food. Therefore, the occurrence of mycotoxins in meat products showed that consumers are at risk of contracting severe health problems when they are consumed. Hence, this call for an urgent need for concerned regulatory bodies to impose necessary measures to safeguard the health of consumers. This also requires that standard methods for identification should be put in place in order to reduce the inflow of contaminated products into the market to minimize the deleterious effects caused by their consumption.

To control the incidence of mycotoxins and establish microbial safety in meat products, emphasis should be placed on the prevention and determination of contaminants especially, toxigenic fungi growth (Núñez et al., 2015). There is evidence that fungus growth can be efficiently controlled in food products by using chemical preservatives (such as salting), modified atmosphere packaging, drying and ripening methods, gamma irradiation application etc. Household-practiced physical methods such as cooking and baking could be used to control the growth of fungi on meat products.

8. Conclusion and Future Prospects

The production and consumption of dried meat are increasing geometrically across Nigeria nowadays although there are few studies indicating the presence of microbial contamination which may hamper or compromise their production in the future. Moreover, findings from this study have revealed that dried meat products are essentially rich in nutrient and could be consumed when properly processed and handled. There is a need to consistently examine the microbiological properties of meat products especially with modern day techniques and equipment's in order to ensure the development of safe food products for consumption. To do this, efforts should be geared towards reducing the source of contamination during production chain especially during processing, drying, storage and point of sale. The inability to know the exact species of animal used for production of tinko meat during marketing is still a challenge in Nigeria. The government and all stakeholders should enact a policy that will ensure that dried meat products such as tinko are properly labelled to indicate meat type and species of animal used during production before marketing to consumers. More studies should be conducted in different parts of the country using modern technology such as High-Performance Liquid Chromatography (HPLC) in order to ascertain the microbial safety of dried meat products for post-production consumption**.**

Author Contributions

The percentage of the author contributions is presented below. The author reviewed and approved the final version of the manuscript.

	A.B.F.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision

Conflict of Interest

The author declared that there is no conflict of interest.

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