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Assessment of Environmental Health Impact of Houses on Food in Warm-Humid Climate, Nigeria

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ABSTRACT: Food poisoning is an acute Non-Infectious Disease (NID), of which its study in relation to residential houses rising dampness has not been well documented. The study aims to determine the correlation of residential houses rising dampness and food contamination in staple convenience food items commonly kept in damp houses in Iseyin Local Government Area (LGA); determine convenience food items commonly kept in the identified damp houses in Iseyin LGA; determine the prevalence and concentrations of regulated mycotoxins (aflatoxins) in the selected common convenience food items kept in Iseyin LGA.; Major information sourced through the questionnaire include demography, occupation, history of occupancy, food commonly kept, likely illness/disorder they used to suffer from, and methods of food storage. And, food exposure experimentation was conducted on the three leading common convenience foods and analysed for potency lost to aflatoxins contamination in the three categories of house. Analysis of the measurements of level of dampness demonstrated that high distribution of damp houses was an indication of absence of installation of Damp-Proof Course (DPC) in the foundation, in the inspection chamber as well as in the floor and wall of bathroom. Analysis of measurements of orientations of selected houses demonstrated that high distribution of damp houses was associated with poor building planning and design. Analysis of responses demonstrated that gari, korongbo, and aadun were largely savoured respectively. Analysis of contaminants demonstrated that high rate of aflatoxins contaminant was associated with non-compliance of housing moisture content. The results indicate that there is positive significant relationship between residential houses rising dampness and contamination of food kept in damp houses. On this basis, it is recommended that federal government enacts National Building Code (NBC) as a key instrument in controlling and sanctioning of housing condition. Further research is needed to identify other factors that could strengthen the effectiveness of this methodology.

I. INTRODUCTION

Foods are, more often than not, vulnerable to fungi-spoilage except with adequate preservative techniques (Bankole, 1994; Bayman and Baker, 2006; Richard, 2007;Adejumo and Adejoro, 2014). Consciousness of the factors of contamination determines the rate of its incidence (Jonathan and Esho, 2010). Molds are parasitic and toxic with their secondary metabolites known as mycotoxins causing zoonotic mycotoxicoses.

The genera of mycotoxigenic fungi include Aspergillus, Penicillium, Fusarium, Trichoderma, Trichothecium, Alternaria, etc. Their proliferation and health effects in African region has attracted extensively the attention of researchers such that studies including study of impact of housing rising dampness on emissions and types of reactive and non-reactive Volatile Organic Compounds (VOCs) and the indoor air quality (Claeson, 2006); study of source of housing dampness in tropical savannah (Agyekum and Ayarkwa, 2014); study of impact of housing rising dampness on the rate of metabolites in living room floor dust of 1-year-old children and asthma development (Kirjavainen and Taubel et. al., 2006); and study of architectural cause of dampness in the walls of residential houses in tropical savannah (Itelima and Itelima, 2017).

With southerner Nigerians facing increased hazards of housing rising dampness cum negligence to the National Building Code (NBC), the need to fill this knowledge gap justifies the undertaking of this research work in tropical savannah of Nigeria.

II. METHODS

2.1 Sampling Procedure and Sampling Size

Multistage sampling method was adopted for this study.The first stage involved a random selection of 600 houses (sample size) from the traditional compound and new sites of the study area.The secondstage involved a random selection of 300 (i.e. 50% sample size) houses from sample size for housing diagnosis.The third stage involved a purposiveselection of a 100 (i.e. 33%) diagnosed damp houses (from the sample size) for questionnaire administration.

This 33% gave rise to about 100 houses that constituted the sample size for the cross-sectional study, from which a total number of three hundred (300) respondents were drawn while the fourth stage involved sampling three case study houses, one representative each, from diagnosed non-damp, fairly damp, and poorly damp houses respectively in the study area for foods exposure's assessment. The bulk (65%) of height of dampness that is in excess of one metre in this study indicates a relative high vulnerability of the cement sandcrete hollow block house types, which is the order of the day in the study area (Safeguard Europe Limited, 2007).

2.1.1 Method of data collection

Primary data used in this study was obtained through a well-structured questionnaire for the respondents (occupants) on the stated objective one of the study.

2.1.2 Identification

Residential buildings that have conspicuous dampness were identified via visual inspection in the study area. A randomly sampled three hundredhouses (i.e. 50% of sample size) inspected were labeled accordingly with special code in the order of zone, community, assigned number, building type, and building style as stated in Table 1.

Table 1: Coding for House Samples

Major Division	Sub Division
Zones	Isalu (IS), Koso (KS), and Ekunle (EK)
Communities	Ogunbado (Og), Omoloju (Om), Gbegi (Gb), Barracks (Ba), Sawmill (Sa) etc.
Assigned numbers	001 to 300
Building types	Bungalow (B), and Storey building (S)
Building styles	Face-to-face (ff), and flat (ft)

2.1.3 Measurement of height dampness

The length of the tidemark was measured using tape measure and divided into three equal distances.

These were marked with permanent marker as the spots for measuring tideline and moisture content. The height of the level of damp rise was measured at the three spots to one decimal place and the average was considered for ranking the damp houses as stated in Table 2.

Table 2: Ranking for Damp Houses

Height of Dampness	House Rank
≤ 0.5	A
0.5-0.8	B
0.9-1.2	Θ
≥ 1.3	Φ

2.1.4 Moisture content determination

The moisture content was measured by placing moisture meter(Tech Check PLUS Version 2.02 Moisture Meter) activated for drywall mode on the marked spots on the selected and coded houses (Agyekum and Ayarkwa, 2014). The moisture content of the selected and coded damp houses was measured at the three spots to one decimal place and the average was considered for grading the damp houses as stated in Table 3.

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Table 3: Grading of Houses Based on Moisture Content

Moisture Content (%)	Grading
0.2-2.0	Good
2.1-3.0	Fair
3.1-5.0	Poor
5.1-≥6	Very poor

Source: (Mydin, 2015)

2.1.5 Evaluation of patterns of building orientation

The orientation of the selected and coded buildings was determined by placing prismatic compass for surveyor parallel to the length of each of the selected buildings. The degree of deviation from true North-South orientation for each was recorded according to the method used by Ahamed and Christoffer (2018).

2.1.6 Development and distribution of questionnaire

Questionnaire was developed for the occupants of the identified and coded houses in order to identify the commonly kept convenience foods.

Major information sourced through the questionnaire include demography, occupation, history of occupancy, food commonly kept, likely illness/disorder they used to suffer from, and methods of food storage. Three questionnaires were distributed to adult occupants of each identified and coded house. The filled and completed questionnaires were collected and evaluated using statistical tools embedded in Microsoft Excel 2002 package (Leahy, 2002).

2.1.7 Measurement of variables

The study comprises both dependent and independent variables.

a. Independent variables

The independent variables of this study include the socio-economic characteristics of the occupants of selected houses. Some of which are:age, sex, religion, marital status, household size, years of occupation, years of formal education, type of convenience foods commonly kept in their houses, type of food storage facilities possessed, regularity of consumption of convenience foods, level of income per month**,** andprimary occupation.

b.Dependent variable

The dependent variables include the relationship between housing rising dampness and moisture content found on the wall; the relationship between housing rising dampness/moisture content and food contamination; the relationship between varying convenience food and concentration of regulated mycotoxins; and the relationship between number of days of food exposure and concentration of regulated mycotoxins invading the food. The measurements for the variable were calculated. The minimum measurements' range of the variable (i.e. moisture content) was0.2-2.0% (good) while the maximum acceptable measurements' range was3.1-5.0% (fair). The maximum unacceptable measurements' range of the variable was5.1-≥6% similar to grading used byMydin(2015) with slight modification.Regulated mycotoxin (i.e. Aflatoxin) extraction was conducted according to the procedures suggested by Egbuta et al., (2015) with slight modification.

2.2 Food Sampling

Selected food samples (3) deduced from questionnaire was placed in a petri dish, which is covered with sterile cotton gauze in damp houses graded as Grade A, B, and C. Each food sample was divided into nine, of which three each were exposed through three, six, and nine days, respectively. They were covered and sealed up with cellotape as being collected in sterile sample collection bags and transported to the Chemical Engineering Laboratory, Unilorin, Ilorin, Kwara State, Nigeria.

Each (1.00±0.05g) of the homogenized food samples made from tissue and corn (gari and aadun) were taken, respectively. 5 mL of sample extraction was added and shaken properly for 3 minutes. It was centrifuged at 4000 rpm for 10 minutes at 20 °C.

The supernatant (100 µL) was transferred into a new centrifugal tube when 700 µL of redissolving solution (1x) was added and shaken well. 50 µL of sample was taken for further analysis at dilution factor of 40 of the samples. Homogenized sample (1.00±0.05g) of peanuts was taken. 5 mL of sample extraction and 4 mL of N-hexane were added and shaken properly for 3 minutes. It was centrifuged at 4000 rpm for 10 minutes at 20 °C. The middle layer (100 µL) was transferred into a new centrifugal tube when 400 µL of redissolving solution (1x) was added and

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shaken well. 50 µL of sample was taken for further analysis at dilution factor of 25 of the samples.

2.3 Total Aflatoxins Extraction Procedure

Clean-up and extraction of Aflatoxins (AFs) using Total Aflatoxins ELISA Kit (Catalog Number CSB-E09923) for competitive inhibition enzyme immunoassay technique was carried out based on the methods used by Mwanza (2007) with slight modifications.This immunoassay kit allows for the in vitro quantitative determination of total aflatoxins concentration in feed, peanuts, rice, corn, edible oil, and tissue. Standards were added to the appropriate microtiter plate wells with an Aflatoxins specific antibody and Horseradish Peroxide (HRP) conjugate anti-antibody.

The competitive inhibition reaction was launched between pre-coated Aflatoxins and Aflatoxins in standards or samples with the Aflatoxins special antibody. A substrate solution was added to the wells and the colour developed in opposite to the amount of Aflatoxins in the standars or samples. The colour development was stopped and the intensity of the colour was measured within a detection range of 0.02-1.62 ppb (Mwanza, 2007).Three samples of known concentration were tested twenty times on one plate to assess the precision of the method employed for total Aflatoxins extraction from samples, which showed that both intra-assay precision and inter-assay precision is CV%<10%, similar to the methods of validation used byEgbuta (2015).

2.4 Statistical Analysis

Descriptive statistics, t-test, Chi-square were performed to analyze results. The values were compared by least significant difference using all pairwise multiple comparison procedures. Analysis was done in three replications and mean values among treatment groups were deemed to be different if the level of probability is <0.05

III. RESULTS

3.1 Assessment of Height of Dampness

The distributions of height of dampness of the sampled houses in Iseyin L.G.A. were shown in Figure 1. Heights of dampness 0.9-1.2 have the highest frequency distribution of 156(52%). This is followed by 0.5-0.8 with a value of 90(30%), and ≥1.3 which has frequency of 40(13%). The lowest frequency of 14(5%) occurred at height of dampness ≤0.5. Generally, height of dampness of ranges ≤ 0.5, 0.5-0.8, 0.9-1.2, and ≥1.3 are rated as good, fair, poor, and very poor. This study shows that bulk (65%) of damp houses identified in the study area are poorly damp.The height of dampness above one metre observed in this study suggests that the cause of dampness is not exclusive to absence of DPC at the foundation, the cause includes absence of structural liners component at both the inspection chambers as well as in the floor and wall of bathroom as represented in Figure 1.

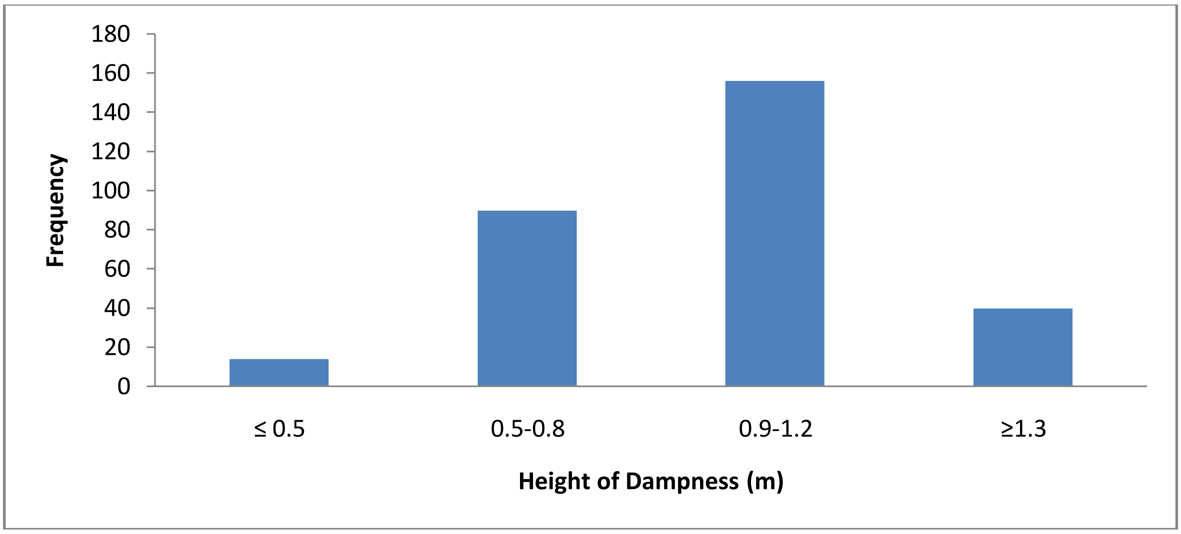

Figure 1: Distribution of Height of Dampness (m) on the Houses Studied

3.2 Moisture Content of Houses Sampled

The moisture content distributions of the sampled houses in Iseyin Local Government Area (LGA) were shown in Figure 2. Moisture content ranking 0.2-2.0 has the highest frequency of 116(39%). This is followed by 2.1-3.0 with a value of 80(27%) and 3.1-5.0, which has frequency of 56(18%). The lowest frequency of 48(16%) occurred at moisture content ranking of 5.1-≥6.0. Generally, moisture content of ranges 0.2-2.0, 2.1-3.0, 3.1-5.0, and 5.1-≥6.0 are rated as 'good', 'fair', 'poor' and very poor respectively.

This moisture contents on the buildings showed that about three in ten (34%:66%) of houses identified in the study area are damp. The result obtained in this study is better in comparison with Itelima (2007) that found that about eight in ten houses are damp in the Savannah Forest of Jos though, techniques employed are different. This result implies thatenvironmental criteria such as geographical and technological required for an acclimatized house (Akande, 2010) is missing. Furthermore, these results indicate an indictment of non-existence of National Building Code (NBC), in which it is expected that Damp-Proof Course (DPC) should be embedded in foundation ahead of footing as well as on floor and wall surfaces of bathroom, and inspection chamber ahead of finishes of any building intended to be erected in the nation.

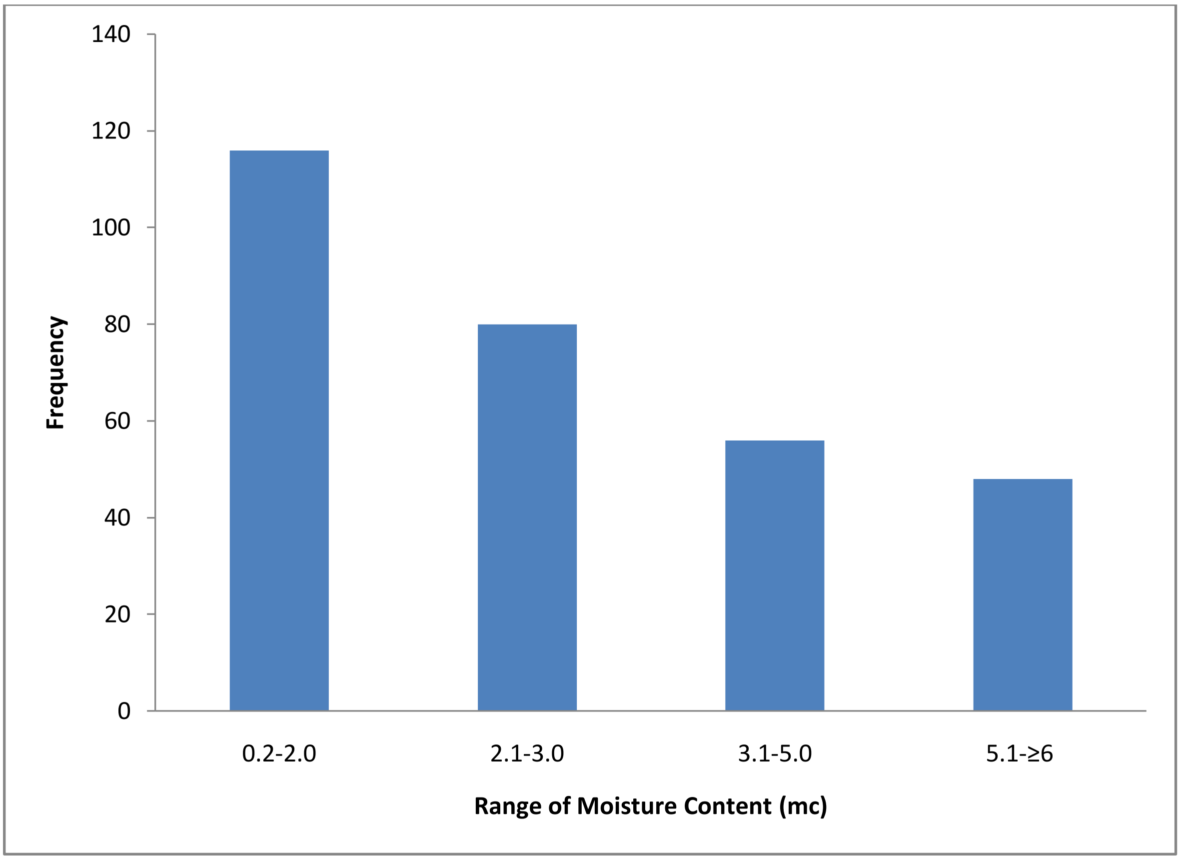

Figure 2: Moisture Content (mc) on the Houses Studied

3.3 Orientation of Damp Houses

House facing North-South directions is required in the warm-humid climate. Meaning it is well placed given the prevailing solar radiation and wind direction. The sun rising from the East and setting in the West gives it best orientation not only for the protection from the sun along the west-east axis, but also for thorough disinfection of walls that are vulnerable to humidity overnight, when the north and south sides that are protected from humidity by an overhanging roofing may be okay with minimal exposure to solar radiation. The orientations of the identified sampled damp houses in the study area were illustrated in Figure 3. This is the degree of deviation of house orientation from true North. The results derived from this study confirm the earlier study of Akande (2010), which

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concluded that most houses in Nigeria are not given due proper orientation.

Only two houses have zero degree of deviation, which means that it conforms to the reference standard for warm-humid climate (Ahamed and Christoffer, 2018). Investigation of the building orientations of the identified sampled damp houses in the study area shows that 38(12.7%) of the houses examined deviate from true North by 10 degree, 37(12.3%) deviate by 20 degree, 39(13%) deviate by 30°, 47(15.7%) by 40°, 32(10.7%) by 50° 25(8.3%) by 60°, 26(8.7%) by 70°, 39(13%) by 80°, to 15(5%) deviate by 90°. only 2(0.06%) houses did not deviate from true north-south orientation.

Houses with 0° deviation conform to the reference standard for warm-humid climate (Ahamed and Christoffer, 2018). Houses 38(12.7%) deviate from true North by 10 degree. Buildings with 10° and 20° deviation with the frequencies 38(12.7%) and 37(12.3%) are considered to be fairly acceptable, while buildings with 30°, 40°, 50°, 60°, 70°, 80° and 90° deviation with frequencies 39(13%), 47(15.7%), 32(10.7%), 25(8.3%), 26(8.7%), 39(13%), and 15(5%) are considered to be poorly oriented accordingly.

This study shows that bulk (74.3%) of the damp houses identified in the study area are wrongly aligned. This result obtained in this study suggest that first apart from the absence of NBC, the available National Housing Policies too did not include provisions for site selection, analysis and planning. Two, the majority of the house owners, building operators (such as architect, town planners, as well as authority in charge, (i.e. Federal Ministry of Land and Housing), and labour force do not have information about the health implication of not arranging houses along true north axis.

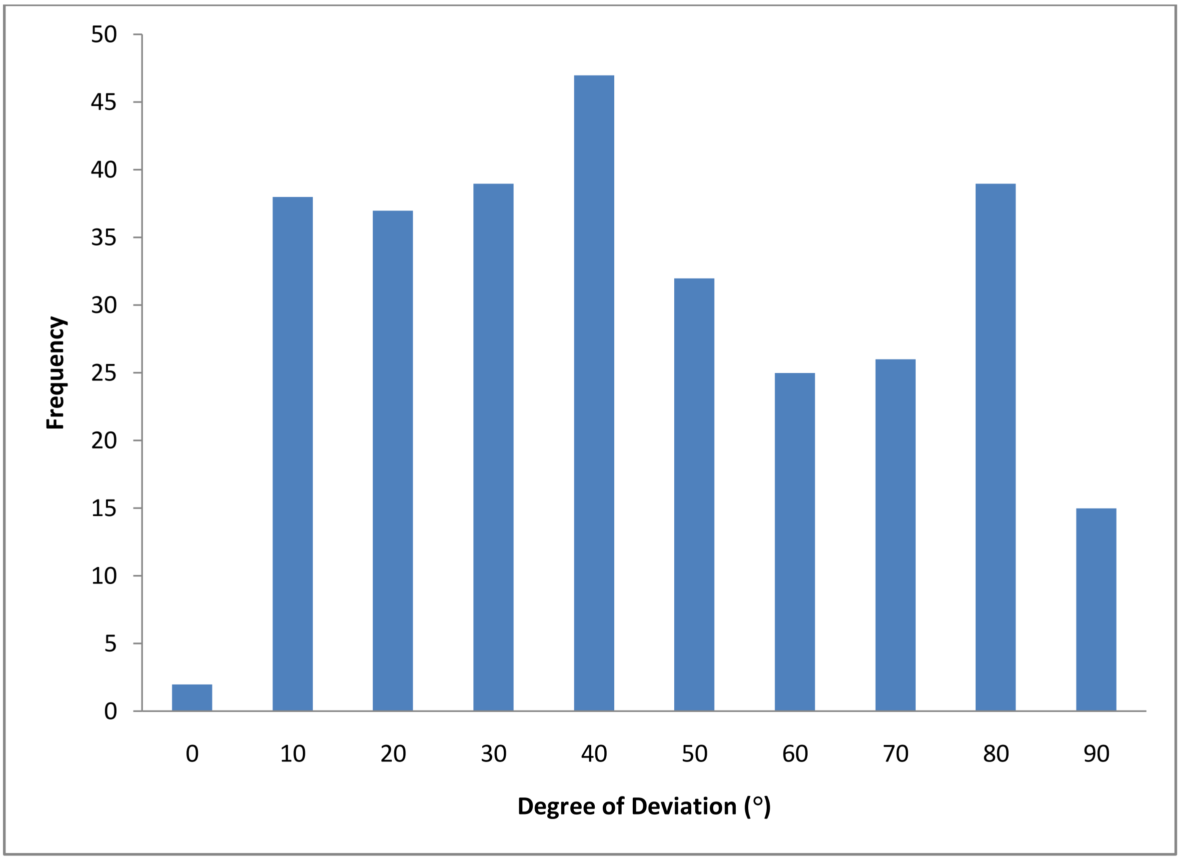

Figure 3: Degree of Deviation **(°)** of Houses from the True North

The predominance of foods was as shown in Table 4. Investigation of the convenience foods predominant in the study area showed that foods range from aadun was savored by 50(18%), Fish pie savored by 7(3%), Eran'gbe savored by 5(2%), Chin-chin savored by 40(14%), Akara savored by 35(12%), Gari savored by 65(23%), Robo savored by 20(7%), to korongbo, which is savored by 60(21%). Highest 65(23%) of those polled were for gari. This is followed by those for korongbo

60(21%) and those for aadun 50(18). 40(14%) polled for chin-chin, 35(12%) polled for akara, and 20(7%) polled for robo implies that they are fairly predominant, while 7(3%) polled for fish pie and 5(2%) polled for eran'gbe implies they are not part of the acceptable delicacy in the study area.

Highest predominance of gariin the study area was chiefly due to the study area being agrarian setting, wherein the world's largest cassava is produced (FAOSTAT Database, 2014). This may also be linked to the presence of high level of low-income earners, and provision of income and employment opportunities to the populace of Iseyin (Githunguri et. al., 2007). Korongbo was a local delicacy of Iseyin, while aadun is attached to the ceremonial culture of the ancient town, especially Iseyin. Chin-chin is fairly accepted because it is non-native to Iseyin.Akara is not dry food and it being produced frequently, so no need keeping and robo has popularity reducing among young generation.

Table 4: Predominance of Convenience Foods Kept in Households in Iseyin

Food Items	Frequency	%
Aadun	50	18
Fish pie	7	3
Eran'gbe	5	2
Chin-chin	40	14
Akara	35	12
Gari	65	23
Robo	20	7
Korongbo	60	21

Field survey, 2019

3.4 Assay of commonly kept convenience foods for aflatoxins

The presence and quantification of total aflatoxins in common convenience foods kept in damp houses in the study area are illustrated in Figure 4. The control sample of corn product (Aadun) has total aflatoxin -0.3169 ppb. Natural sample of Aadun has total aflatoxin -0.69598. Aadun kept in non-damp (A) house have total aflatoxins 0.19864 ppb, 0.3169 ppb, and 2.30629ppb in days three, six, nine, respectively.

Aadun kept in fairly damp (B) house have total aflatoxins 1.5501 ppb, 4.30781 ppb, and 7.85595 ppb in days three, six, nine, respectively. Aadun kept in poorly damp (C) house have total aflatoxins 3.8044 ppb, 5.91509 ppb, and 9.34193 ppb in days three, six, nine, respectively. Corn products kept in poorly damp house across the days have highest total aflatoxins. This is followed by foods kept in fairly damp house. Foods kept in non-damp house have the least total aflatoxins across the days.

The control sample of peanuts product (Korongbo) has total aflatoxin -0.2714 ppb. Natural sample of peanuts has total aflatoxin 3.943897 ppb. Korongbo kept in non-damp house have total aflatoxins 3.86808 ppb, 1.51782 ppb, and 1.3177 ppb in days three, six, and nine, respectively. Korongbo kept in fairly damp house have total aflatoxins 4.27748 ppb, 4.59591, and 5.73313 ppb in days three, six, and nine, respectively. Korongbo kept in poorly damp house have total aflatoxins 5.82411 ppb, 6.05155 ppb, and 6.17286 ppb in days three, six, and nine respectively. Foods kept in poorly damp house across the days have highest total aflatoxins. This is followed by foods kept in fairly damp house.

The control sample of tissue product (White Gari) has total aflatoxin -1.3177 ppb. Natural sample of white Gari has total aflatoxin 4.459439 ppb. Gari kept in non-damp house have total aflatoxins 1.86657 ppb, 1.59363 ppb, and 0.2714 ppb in days three, six, and nine, respectively. White Gari kept in fairly damp house have total aflatoxins 1.19939 ppb, 2.9583 ppb, and 2.98863 ppb in days three, six, and nine respectively. White Gari kept in poorly damp house have total aflatoxins 3.42836 ppb, 4.65656 ppb, and 8.52312ppb in days three, six, and nine, respectively. The results of this study shows that the higher the level of dampness the higher the concentration of total aflatoxins and vice versa.

Relatively, aflatoxins contaminants (5.73313, 5.82411, 6.05155, and 6.17286 ppb) found in peanuts products all through the nine days of exposure are highest and fall within the set standards (0.5-15 ppb) by Joint Food and Agricultural Organization/World Health Organization FAO/WHO harmonized international food standards for contaminants and natural toxins in food. This is followed by contaminants (5.91509, 7.85595, and 9.34193 ppb) found in corn

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products all through the nine days of exposure that fall within the set standards (0.5-15 ppb) by Joint Food and Agricultural Organization/World Health Organization FAO/WHO harmonized international food standards for contaminants and natural toxins in food (FAO/WHO, 2004).

The least contaminants (8.52312 ppb) all through the nine days of exposure that fall within the set standards occurred in tissue products. These results indicate that peanuts product is most prone to mycotoxin - Aflatoxins (AFs) - contamination, followed by corn products, while tissue products observed to be least prone to aflatoxins contamination. The results of exposure assessment in this study showed that all the three convenience foods kept within nine days' exposure to damp houses maintain their potency; hence safe for consumption based on Standard Organization of Nigeria (SON) which put maximum levels to be 10 ppb (SON, 2013); and, Joint Food and Agricultural Organization/World Health Organization FAO/WHO harmonized international food standards, which put maximum levels to be 0.5-15 ppb for contaminants and natural toxins especially aflatoxins in food (JECFA/FAO/WHO, 2004).

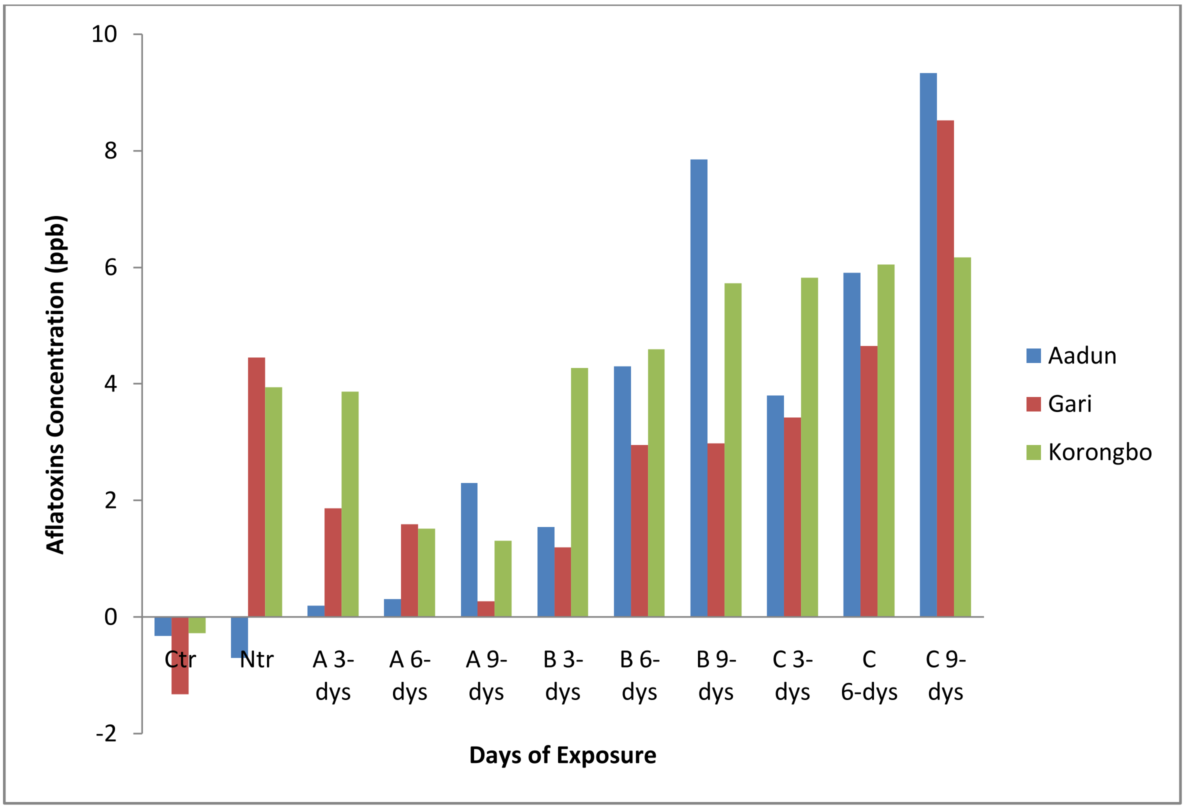

Figure 4: Relativity of Foods Vulnerability to Aflatoxins

3.5 Statistical Analysis

The test of significant difference of Housing Rising Dampness (HRD) and Moisture Content (MC) in this study was as shown in Table 5. Comparing the P-value (0.000) to set significance level (0.01) since the t-value (6.802) is greater than 2.5, the P-value (0.000) is less than level of significance (0.01) and hence the null hypothesis was rejected. This implies that the alternative hypothesis ($H_{1:}$ $\mu \neq x$) is correct, and that the data is very significant. The confirmation of the great significant difference in-between housing rising dampness and moisture content in this study translates into tidemark/dampness manifested by most buildings' walls in a warm-humid climate of Nigeria is ground-sourcedrising dampness from saturated soil, especially of buildings without damp proof course. This means there is a great and direct difference, as housing rising dampness increases the moisture content increases and vice versa.

Iseyin being located in lower edge of Rainforest tropical climate classified as tropical savannah (Kopen-Geiger Climate Classification) recordedlonger rainy season that influences rise in water table, occurrence of flood, and low evaporation.Generally, most houses are sandcrete hollow block type that consists of Calcium Oxide

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as the binding agent, which is hygroscopic whenever it comes in contact with water.

Table 5 Test of significant difference between housing rising dampness and moisture content using T-test analysis

Variable	Mean	T	Df	Sig(2-tailed)	Decision	Remark
HRD-MC	1.824	6.802	88	0.000	S	Reject H_0

Source: Data Analysis, 2019

The test of significant relationship between Housing Rising Dampness (HRD)/Moisture Content (MC) and food contamination in this study is as shown in Table 6.

From seekingrelationship between housing rising dampness/moisture content and food contamination, since the p-value (0) of moisture content is less than our chosen significance level ($\alpha = 0.05$), we reject the null hypothesis. It is therefore concluded that there is enough evidence to suggest an association between housing rising dampness/moisture content and food contamination with mycotoxins. Based on these results, we can state that association was found between housing rising dampness/moisture content and food contamination with mycotoxins ($X^2(26)< = 1085.955$, $p = 0$). This means there is a direct relationship, as housing rising dampness/moisture content increases, the chance of contamination of food kept in damp houses increases, especially dry based convenience foods and vice versa.

Table 6 Test of significant relationship between housing rising dampness/moisture content and food contamination with mycotoxins using chi-square analysis

Indep.Var.	X^2-Value	Df	Asymp.Sig.	Decision	Remark
HRD	36.966	36	0.424	NS	Accept H_0
MC	1085.955	26	0	S	Reject H_0

Source: Data Analysis, 2019

Legend

X^2- Chi-Square, NS – Not Significant, and S – Significant

IV. DISCUSSIONS

From the environmental measurement conducted, the bulk (65%) of height of dampness that is in excess of one metre in this study indicates a relative high vulnerability of the cement sandcrete hollow block house types, which is the order of the day in the study area (Safeguard Europe Limited, 2007).

The height of dampness above one metre observed in this study suggests that the cause of dampness was not exclusive to absence of Damp-proof Course (DPC) at the foundation, the cause includes absence of structural liners component at both the inspection chambers as well as in the floor and wall of bathroom. This study shows that about three in ten (34%:66%) of houses identified in the study area were damp. The result obtained in this study was better in comparison with Itelima (2007) that found that about eight in ten houses are damp in the Savannah Forest of Jos though, techniques employed are different. This result implies that environmental criteria required such as geographical and technological for an acclimatized house (Akande, 2010) is missing.

Furthermore, these results also indicate an indictment of non-existence of National Building Code (NBC), in which it is expected that Damp-Proof Course (DPC) should be embedded in foundation ahead of footing as well as on floor and wall surfaces of bathroom, and inspection chamber ahead of finishes of any building intended to be erected in the nation (Nigerian NBC Draft, 2006). This study shows that bulk (74.3%) of the damp houses identified in the study area are wrongly aligned. This result obtained in this study suggest that first apart from the absence of NBC, the available National Housing Policies too did not include provisions for site selection, analysis and planning.

Two, the majority of the house owners, building operators (such as architect, town planners, as well as authority in charge, (i.e. Federal Ministry of Land and Housing), and labour force do not have information about the health implication of not arranging houses along true north axis. The results of foods' exposure assessment revealed that varying foods kept up to nine days though safe according to the standards by (SON) and FAO/WHO, are at the border line to becoming lost to mycotoxins AFs.

It is therefore concluded that there is enough evidence to suggest the presence of an association between housing rising dampness/moisture content and food contamination with mycotoxins. Hence, association was found between housing rising dampness/moisture content and food contamination with mycotoxins ($X^2(26) <= 1085.955$, $p = 0$). This means there is a direct relationship, as housing rising dampness/moisture content increases, the chance of contamination of food kept in damp houses increases, especially dry based convenience foods and vice versa.

V. CONCLUSION

In conclusion,visual examination of houses showed presence of tidemark in 285(95%) of the sampled houses and this indicated the importance of this study to the sampled sites since more than half houses experienced dampness. Out of the examined houses, 116(39%) of the houses rating indicated that the moisture content is compliant while moisture content of 184(61%) houses were not compliant, which indicated that more than 50% of the houses examined were rated non-compliant as a result of high moisture content.

Two (2) which is 0.06% of the houses measured showed that building orientation is compliant while 298(99.04%) houses were found to be poorly oriented, which indicated that more than 99% of the houses examined were wrongly sited. Mycotoxins prevalence increases as the days of exposure increases across all the three food samples, although higher in both Aadun and Korongbo than in Gari. Generally, this implies that mycotoxins increase in food kept in damp houses as the day increases. Statistical analysis of HRD/MC and food contamination revealed that there is significant relationship.

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