

CONSUMER PREFERENCE OF TERMITES *Pseudocanthotermes grandiceps* (Isoptera: Termitidea) IN WESTERN KENYA

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Abstract: Kenya faces acute food shortages to satisfy the increasing population as traditional food stocks continue to be depleted as a result of environmental changes and increasing population. Faced with problems of food insecurity, increasing food prices and overreliance on the traditional food items, there is an urgent need for Kenyans to diversify their food sources. In western Kenya, termites (white ants) have a long history of consumption as a delicacy during the rainy seasons. A major problem is that the termites are varied in species and may not all contain the ingredients required by humans for nutrition. The aim of this study was to establish the consumer preferences for the white ant (*Pseudocanthotermes grandiceps*) species in various urban centers of Kenya. This was done with an overall aim of determining whether white ants can be declared as an alternative food source in Kenya. Data was collected and analyzed. consumer preference was done through personal administered questionnaires that sought direct information on the issues of consuming white ants. Qualitative data from the questionnaires and interviews collected during this study were analyzed by descriptive statistics employing tools of central tendencies, frequency distributions, cross tabulations and chi-square (χ^2) of goodness of fit tests using SPSS version 17.0. Chi-square test was suitable here since enabled the identification of any significant differences in the frequencies of the alternative response. All data was analyzed at a level of $p < 0.05$. After analysis, data were presented using table, bar graphs and pie charts. The median ingredient uptake volumes were calculated based on the respondents responses, which were then used to calculate the daily ingredient intake. The first survey identified that local consume beef, poultry, vegetables mainly traditional, cabbages, fish, and white ants. The consumers were asked to rank foods that should be considered a delicacy and should be advocated for all the Kenyan to take as long as they are available. The results show that beef ranked highest followed by white and brown ants respectively. Bacon and wild birds ranked lowest.

Keywords: white ants consumer, preference, termites, *Pseudocanthotermes grandiceps*, nutrition.

1. INTRODUCTION

Termites live in colonies consisting of a few thousands to several million individuals. Termites are a moderate sized insect order (2600 described species) accepted to be an extremely important part of tropical and sub-tropical ecosystems (Eggleton, 2001). The tropical environment is known for its rich fauna and enormous population of termites, which are supposed to play an important role in the rapid turnover of organic matter in the ecosystem (Onyonka, 2001). The seventh family, Termitidea, represents over 80% of all termite genera and 74% of all termite species. Due to location in the tropics and climate, Kenya, like most of the tropical environment possesses one of the most diverse biota in the world. The genus *Nasutitermes* is taxonomically diverse with over 180 species (Krishna, 2010) and broadly distributed, being found in six of the eight major biogeographical regions (Pearce and Waite, 1994).

termites have been historically consumed in many parts of the world for time immemorial. Its delicacy is well known to be safe for consumption many people in Kenya (Onyonka, 2001) and its abundance is unquestionable. It is apparent in Kenya that there is problem of food insecurity, which has been a major issue that the Government has been addressing. The population growth rate in Kenya is increasing at a rate of 6%.

Historically, Kenya has relied intensely on agriculture to support more than 70% of her population. In the 1970s, sustained growth of agriculture above 10% per annum coupled with favorable weather patterns, witnessed unrivalled increase in Kenya's gross domestic product (GDP) by over 7% annually and therefore, the momentous economic growth was sustained, reducing food insecurity problems. Currently, the country continues to rely heavily on agriculture as an engine to drive most of its economic growth, provide food, employment and most of the basic needs required by the populace despite the myriads of problems that has continued to duck the sector (Odeny, 2006). However, in Kenya for quite some time now, food insecurity situation has been appalling because of frequent problems of unpredictable weather conditions as well as erratic and intermittent rainfall partly attributed to wanton dynamism in environmental conditions and poor agricultural policies put in place (Waiganjo et al., 2006; Were et al., 2008). With the liberalization of trade and introduction of structural adjustment programmes (SAPS), fertilizer costs have increased to a level unaffordable to small-scale farmers. Rather than rely on agriculture to wholly engineer the economic growth other sources of foods need to be considered. In an effort to bridge the food gap that ails the country, several food sources have been evaluated. Many of these protein food sources have been based on meat and beef products and byproducts. They include animal protein sources such as chicken, beef, burgers, duck, turkey, pig meals among others as well as plant protein sources such as peas, beans, French beans, soybean etc. Whereas they have been providing protein sources for a long time now, they are increasingly becoming expensive and out of reach for many people. Furthermore, livestock are prone to diseases and drought as well as lack of pasture not to mention the constant conflicts that are associated with rearing large herd of cattle. Kenya depends on agriculture to satisfy its food demands. In recent years there have been foreseen and unpredictable weather changes that have exposed the people to poor harvest and declining yields from agriculture. There is therefore, the grave danger of chronic and sometimes acute food shortage that is likely to affect the nutritional and health status of the people. To reduce the chronic food shortages in Kenya, variety of food sources are required white ants being one of them. However, consumer preference and nutritional composition of the white ants that would render it suitable as a food source is unknown, hindering the protocol of declaring it a national food item.

2. MATERIALS AND METHODOLOGY

This study was carried out in Western Kenya Covering Western Province, Nyanza Province and part of the North Rift. In presence of diverse livelihood mainly in the agricultural sector, close to 4 million people have settled in the region, attributable to employment prospects while others are in the District due to immigration. The study area is situated about 300-800 km North West of Kenyan Capital, Nairobi. It lies at an average altitude that ranges between 1800-2600 meters above sea level. The area covers an approximate area of 19200 km². Climate within the study area is strongly influenced by altitude and physical features such as escarpments and volcanic peaks mainly from the Cherangani Hills, to Kakamega forest and hills of Mount Elgon. The area has a high variation in temperature ranging from 10.5 –25.5°C within the year thus favoring growth of agricultural crops within the area. There is a bimodal rainfall; the mean being just over 1000 mm annually.

Populations and land tenure:

It is estimated that the area has slightly over 4 million persons with a density of about 320 persons per square kilometer (KNBS, 2010). The number of households within the study area according to 2010 census is approximately 822,850. Land is under individual ownership and partly through cooperates such as the several forest farms spread along the breath of the area.

Research design:

Interviews and questionnaires were used to collect data through a cross-sectional survey. Such designs are often used for descriptive, explanatory and exploratory purposes (Labovitz and Hagedorn, 2006; Kothari, 2004). It was used to investigate the consumer acceptance of the white ants in the region

Target population and sample size:

The target population consisted of all the people who consume white ants. The number is estimated at 1,000, 000. Sample size was determined from the target population using the formula by Mugenda and Mugenda (1999) $n = z^2 (pq)/d^2$

n = the desired sample size

z = Standard normal deviation (at 95% = 1.96)

d = the acceptable range of error (0.05)

p = the proportion of people who consume white ants in Western Kenya (80%)

q = the proportion of people who do not consume white ants in Western Kenya (20%)

Based on the calculation, the sample size for this study consisted of 240 people from the study area. This number was deemed representative of the target population from each of the heterogeneous sub-groups within the area.

Sampling strategy:

This study employed systematic sampling technique in combination with purposive sampling method to select the respondents for the interviews and those who will answer to the questionnaires. Currently, there are 45 administrative districts in the region. At least 5 people from each district were selected from areas where there are high densities of termites at random until the desired 240 respondents was obtained. The random sampling technique ensured a representative sample was selected on probabilistic criterion and thus allowing each person an equal chance of selection. Additional 10 key informants were included in the sample to provide desired information of the subject at hand.

Research tools and instruments:

Questionnaires and interviews were used as the main tool for data collection. The selection of these tools was guided by the nature of the data to be collected, the time available as well as the objectives of the study. Since the research was concerned with views, opinions, perceptions and feelings, such information was best collected using questionnaires and interview schedule (Touliatos, 1998) since such variables cannot be directly observed. Semi-structured instruments questionnaires were used so that a balance between the quantity and quality of data was collected. Data were collected at designated times at household levels. Questionnaires were given to people who can read and write and they were given the opportunity to fill the questionnaires.

Data analysis:

Qualitative data from the questionnaires and interviews collected during this study were analyzed by descriptive statistics employing tools of central tendencies, frequency distributions, cross tabulations and chi-square (χ^2) of goodness of fit tests using SPSS version 17.0. Chi-square test was suitable here since enabled the identification of any significant differences in the frequencies of the alternative response. All data was analyzed at a level of $p < 0.05$. After analysis, data were presented using table, bar graphs and pie charts. The median ingredient uptake volumes were calculated based on the respondents responses, which were then used to calculate the daily ingredient intake according to the formulas:

$$DI_{ingredient} = \sum_{i=1}^n C_{food} \times I_{food}$$

$$I_{ingredient} = \frac{SS_{median} \times FF_{food}}{30.4}$$

Where $DI_{ingredient}$: the daily intake of ingredient from food ($\mu\text{g/L}$)

C_{food} : the average metal concentration of the item ($\mu\text{g/L}$); I_{milk} : daily food intake (L/day); SS_{median} : the median quantity of the food item consumed (g/day); FF_{food} : food frequency i.e. the number of days in a month that the food was taken by the respondents (days/month). One month was assumed to be 30.4 day (365/12).

3. RESULTS

Socio-economic Backgrounds of the Respondents:

The socio-economic backgrounds of the respondents are shown in Table 3.1. The distribution in sex, levels of education and salary were significantly different among the respondents ($p < 0.05$) while age distributions among the respondents were not significantly different ($p > 0.05$). Many respondents were females, with secondary levels of education. Salary earned by most of the respondents was over Kshs. 1001-5000 per month.

Table 3.1: Socio-economic backgrounds of the Respondents

	Variables	Frequency	Percent
Age (Years)	< 25	28	11.7
	25-35	68	28.3
	36-45	72	30.0
	46-55	47	19.6
	> 55	25	10.4
	Total	240	100
Gender	Female	162	67.5
	Male	78	32.5
	Total	240	100
Levels of Education	None	21	8.8
	Primary	61	25.4
	Secondary	105	43.8
	College	47	19.6
	University	6	2.5
	Total	240	100
Income (Kshs.)	< 1,000	18	7.5
	1,000-5,000	97	40.4
	5,001-10,000	72	30.0
	10,001-20,000	45	18.7
	> 20,000	8	3.3
	Total	240	100

The estimated median consumption of the of white ants was 0.15 g per day, beef was 0.11 g per day and fish was 0.08 g per day for the sampled population based on the food frequency questionnaires (FFQ). Based on the table 3. 2, crude protein levels taken by the respondents per day was 80 g/100g in white ants and lowest in beef at 50 g/100g feed. Crude lipid uptake was also highest in white ants and lowest in beef. However, consumption of white ants provided more ash and crude fiber to the locals than fish and beef. Concerning the essential amino acid uptake, white ants provided the highest levels of all the essential amino acids compared to the fish and beef. However, except for lysine, none of the food(fish and beef) consumed provided the required daily intake of the EAA.

Table 3.2: The calculated average dietary intake (g/100 g/day) of the various ingredients and essential amino acids

Ingredients (% as fed basis)	Food items		
	White ant	Fish	Beef
Dry matter	135.30	98.56	72.17
Crude protein	80.85	73.59	49.78
Crude lipid	14.03	6.09	4.98
Ash	16.22	3.64	2.79
Crude fiber	14.30	9.10	8.19
NFE	9.92	6.14	6.42

Essential Amino acids (g 100g ⁻¹)				Requirements (g/100g)
Histidine	4.53	4.35	1.80	10
Isoleucine	3.84	3.28	2.65	20
Leucine	3.54	2.90	1.93	39
Lysine	8.69	5.73	4.03	4
Methionine	4.17	3.92	2.81	10
Phenylalanine	6.02	5.93	3.94	25
Threonine	3.96	4.41	3.38	15
Valine	1.98	4.26	2.39	26

Values for fish and beef adapted from Cherop *et al.*, 2009 and White ant Values Makila *et al.*, 2018

Consumer preferences for the white ants in various urban centers of Kenya:

To determine the consumer preference of the white ants, information concerning criteria of preference was used and reasons why consumers do not prefer other traditional food sources. The first survey identified that local consume beef, poultry, vegetables mainly traditional, cabbages, fish, and white ants. The consumers were asked to rank foods that should be considered a delicacy and should be advocated for all the Kenyan to take as long as they are available. The results are as shown in Figure 3.1. Fish and beef ranked highest followed by white and brown ants respectively. Bacon and wild birds ranked lowest.

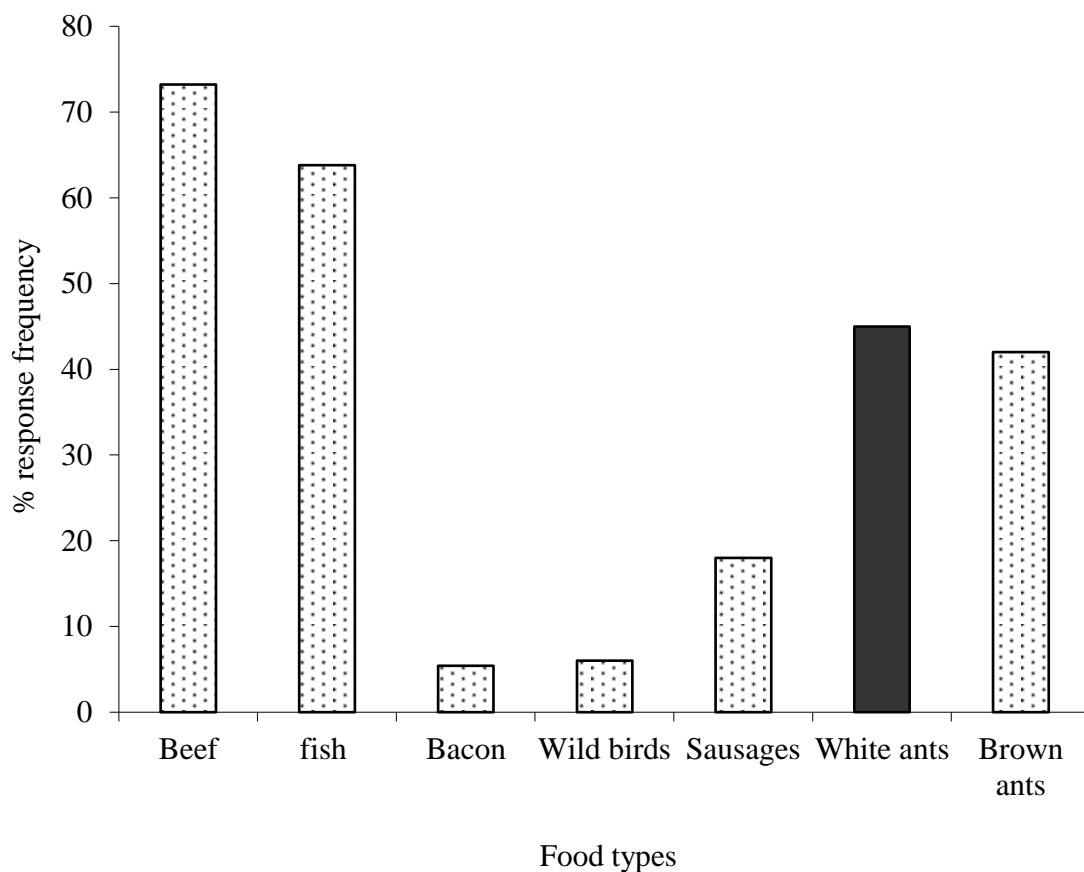


Figure 3.1: Preferences for various food items among the sampled respondents

Information was also sought why they prefer white ants over other sources of proteins. Information concerning the criteria used for ranking white ants among the consumers surveyed is as shown in Figure 3.2. Most consumers preferred white ants because of their cultural attachments (54.2%) followed by their nutritional contents (35.2%) while others believed that it is less costly than other food items. The least number believed that its medicinal values are likely to make it more preferable.

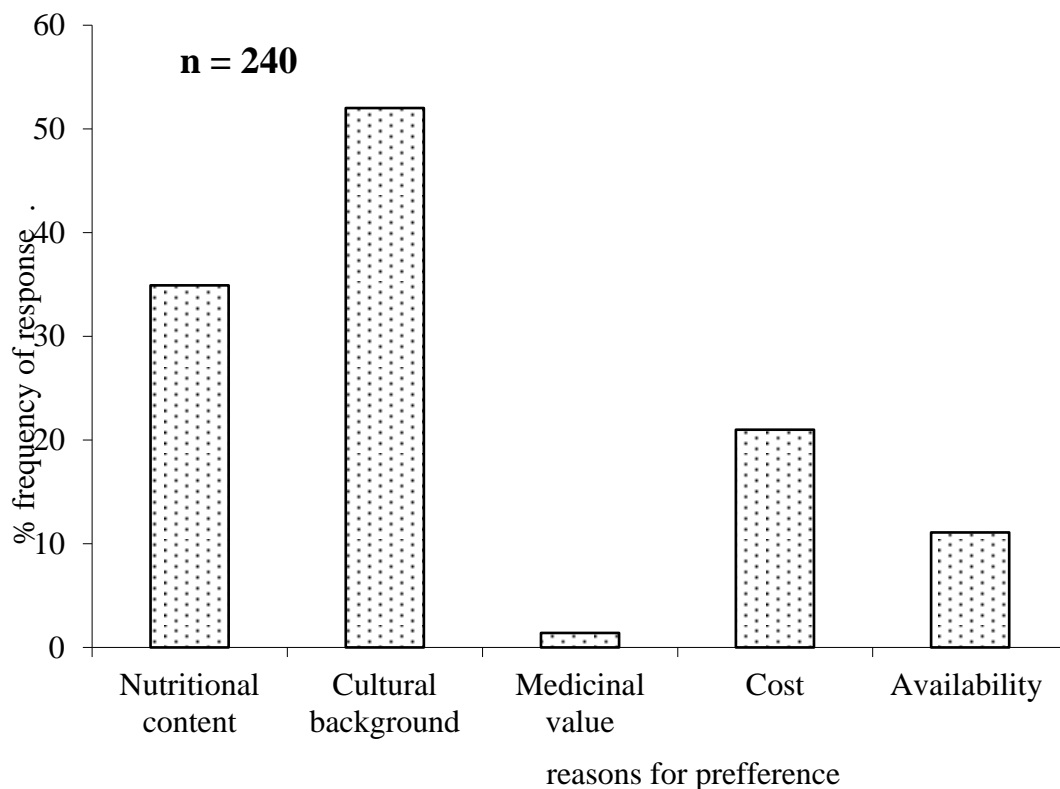


Figure 3.2: Criteria used to rank the white ant as food sources

Further information on why consumers do not prefer 'traditional protein' including white ants is shown in Table 3.3. The main reasons cited by the consumers for not preferring the white ants among other traditional food sources included: high cost of obtaining some of these foods though white ants are not expensive, many people believed that the ants are seasonal and therefore their costs may be relatively higher. Others wanted to abandon old and traditional cultures by embracing the modern food types. Yet others still believed that it is time consuming to prepare the white ants meals, though this seems to be an answer out of ignorance.

Table 3.3: Reasons why the consumers do not prefer white ants

	Frequency	Percent
Abandonment of culture and tradition	67	27.9
Expensive	28	11.7
Time consuming during preparation	86	35.8
Seasonality	58	24.2
Total	240	100

4. DISCUSSION

Consumer preference of the white ants against conventional food sources:

Many Kenyan communities have been observed to use traditional food sources that are highly nutritious without having any scientific attachment to the observed phenomenon. In many parts of the Kenya, white ants are being consumed in many forms. It is the preference of using the white ants that differ in many parts of the country. In Kamukuywa, many people use white ants as a delicacy. The consumers ranked white ants as the third most preferred food item than beef and fish. Though no studies is currently available on the food value of the ants, many Kenyan cherish beef and fish and therefore if white ants ranked third after these food then it is probable to suggest that white ants are actually a preferred foods item. Probably because it is less available, many people do not understand how to obtain it and this could explain why it is not ranked above fish and beef that are frequently available. One of the possible reasons for the reduction in the consumption of white ants could be related to reduction of quantity of the white ants, encroachment of many vegetated zones that were once habitats of white ants as well as changes in the production and consumption patterns of many

communities in Kenya. Preferences of traditional food items in Kenya have been documented to be variable and a function of many interrelated factors. The main reasons however, why the white ants were more preferred was because of their cultural attachments (54.2%) followed by their nutritional contents (35.2%) while others believed that it is less costly than other food items. As already pointed out, no research has been conducted in Kenya to determine the preference of white ants but other reasons for preferring traditional foods are available. Abdala *et al.* 2007 reported preference of local traditional foods in many parts of inland and hinterland parts of Kenya in Murang'a. Furthermore, Wanjiku (2004) also documented after series of field surveys that Kenyans of certain age brackets mainly the old, prefer traditional food items than the young ones. Awiti (1991) documented that between 1960-1980, over 40 varieties of traditional food sources were being consumed across the country. The present study however cannot confirm or deny any reduction in diversity of the traditional food sources in relation to earlier studies because it was only limited to Western Kenya. In his earlier work Awiti considered all traditional food items in Kenya, which was out of current study scope. However, considering the preferences for the few species of established foods such as beef and using evidence from many published literature of the great diversity of traditional food items, in many parts of Western Kenya, all evidence suggest non-preference for a number of traditional food items even though white ants were preferred. This seem to suggest that even though many people are consuming the white ants as a cultural obligation, a vast majority of the consumers who seem to be drifting away from the cultural obligation are the major culprit in the consumption of the indigenous white ants

Consumers did not prefer the white ants among other traditional food sources due to a combination of factors including: high cost of obtaining some of these foods though white ants are not expensive, many people believed that they are seasonal and therefore, its costs may be relatively higher. Others wanted to abandon old and traditional cultures by embracing the modern food types. Yet others still believed that it is time consuming to prepare the white ants meals, though this seems to be an answer out of ignorance. The demand driven supply of product is a principle law governing production and marketing of many products outside convectional agriculture or horticulture (Todaro, 2002). This guarantees by the fact that the people will be willing to purchase what is supplied in the market and sellers will be willing to supply what the people are willing to purchase. Though supply and demand laws seems to be the driving force behind the production and the consumption, other intrinsic factors like flavour, nutrition status and acceptability are also important factors that are worth considering. This therefore implies that sustainability in the production of white ants will be achieved if many people determine the critical role played by these white ants in the diet. It is now more recognized that sustaining the production of white ants will not focus on increasing land area for production but intensification of production per unit area since this is done in situ.

5. CONCLUSION

Consumers' preference of the white ants ranked after poultry and beef mainly because of cultural attachments and nutritive values of the white ants. White ants were not consumed mainly because of the availability.

6. RECOMMENDATION

Ways of enhancing commercial production of the white ants should be improved to ensure that the ants are available as a major food source.

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