



ARTICLE

# Indigenous Knowledge on Production and Utilisation of Termite (*Isoptera*) in Western Kenya

Vugutsa J.E.<sup>1\*</sup> Mosi, R.O.<sup>2</sup> Wambui, C.C.<sup>3</sup>

1. Vihiga County Government, Maragoli, Kenya

2. Jaramogi Oginga Odinga University of Science and Technology (JOOUST), Department of Plant Animal and Food Science, Bondo, Kenya

3. Maseno University, Department of Animal Science, Maseno, Kenya

---

ARTICLE INFO

*Article history*

Received: 19 July 2021

Accepted: 21 December 2021

Published Online: 4 January 2022

---

*Keywords:*

Knowledge

Characteristics

Harvesting

Utilisation

Termites

---

ABSTRACT

The study sought to assess the level of knowledge on the utilization of termites, harvesting methods and characterise local edible termite species. Focus group discussion with key informants was used to collect data that was analysed using SPSS Version 21.0 to generate descriptive statistics. Results indicated different levels of termites' utilisation where 45% of farmers use alates as food, 35% as feed for chicks and quails, while 20% use the queen to fatten young bulls. Majority of farmers (40%) prefer the use of termites as feed because it is readily available, followed with 20% that use it because of nutritive value, 10% relate its use with better taste of poultry products, 5% associate termite use in enhancing early maturity weight while 5% said it improves growth and strength of bulls. On harvesting, three methods are commonly used with most farmers (45%) using underground trapping method, (35%) use above ground trapping method but 20% use mound excavation. Varied plant materials are used as attractants and the effect is more when combined with dry cow dung. Farmers further characterised species based on time of emergence of alates and habitat's physical features. Most respondents (45%) associated: big mounds with *Macrotermes bellicosus* (Mafendete); small mound to *Macrotermes subhyalinus* (Kitunda); presence of open big tunnels with *Coptotermes millitaris* (Riamke) while seasonal galleries and small tunnels was a confirmatory feature of either *Pseudocanthotermes militaris* (Chiisiisi) and *Pseudocanthotermes spiniger* (Maburi). The study demonstrates the richness in indigenous knowledge on techniques of termite production and utilization.

## 1. Background Information

The high cost of protein for use as food and feed coupled with overreliance on use of silver cyprinid (*Rastroneobola argentea*) has evoked the need to explore suitable, available and affordable alternative protein

sources. Currently, insects are being explored due to their established nutritional value and abundancies<sup>[1]</sup>. Unfortunately, there has been paucity of information on their general use, acceptability and harvesting. Their inclusion in poultry diet is likely to form a suitable protein source as opposed to the conventional use of Silver

---

\*Corresponding Author:

Vugutsa J.E.,

Vihiga County Government, Maragoli, Kenya;

Email: [jejosken@gmail.com](mailto:jejosken@gmail.com)

Cyprinid/Omena (*Rastroneobola argentea*) which has competing demands by human and livestock for food and feed. Currently about 200 million people in Africa rely on fish whose supply is declining thus negatively impacting on per capita consumption [2]. Fortunately, termites have previously been used as chicken feed in many countries with proven ability of being palatable and positively impacting on growth and carcass characteristics to birds [3]. This hence forms a basis of reconsidering its inclusion in poultry diet. However there has been a major setback on raising quantities due to seasonality on emergence of alates, poor method of utilization and harvesting techniques [4]. In Bukina Faso, time, unavailability and insufficient knowledge on harvesting technique was a major hindrance towards its effective use as poultry feed [5]. Subsequent study on harvesting method further revealed that harvesting method varies with termite genus, region and season [6]. Due to different geographical regions and difference in termite distribution and diversity, there is likelihood of uniqueness in suitability of method to adopt. This study seeks to ascertain on a method that will suit Kenya related conditions as well as build on indigenous knowledge for easy adoption.

In Western Kenya, there exist various types of termite's species and some have in the recent past been exploited by smallholder farmers as special feed for chicks and quails. A number of farmers have been harvesting soldiers and workers and directly feeding their birds. However, there is still paucity of information and documentation regarding their preference, harvesting technique, material used scope of their use. It is against the background that the study was undertaken to evaluate the knowledge of utilisation and production. This will help to validate and document on above issues for purpose of their effective and sustainable use as suitable substitute to silver cyprinid.

## 2. Methodology

### 2.1 Experimental Site

Vihiga County was purposefully used for the study due to its proximities with the researcher, availability of equipment, experimental materials and the social cultural norms of the community. Termite harvesting techniques were done in County since a section of the community seemed to have traditional knowledge on their harvesting and utilization as food and feed. The County covers a total area of 531.0 Km<sup>2</sup> and has five Sub-Counties (Emuhaya and Luanda Sub-Counties at 173.5 Km<sup>2</sup>, followed by Hamisi 156.4 Km<sup>2</sup>, Sabatia 110.9 Km<sup>2</sup> and Vihiga at 90.2 Km<sup>2</sup>). The County is categorized into two main agro-

ecological zones; the upper and lower midland Vihiga County covers a total area of 563.0 Km<sup>2</sup> with an estimated population of 554,622.

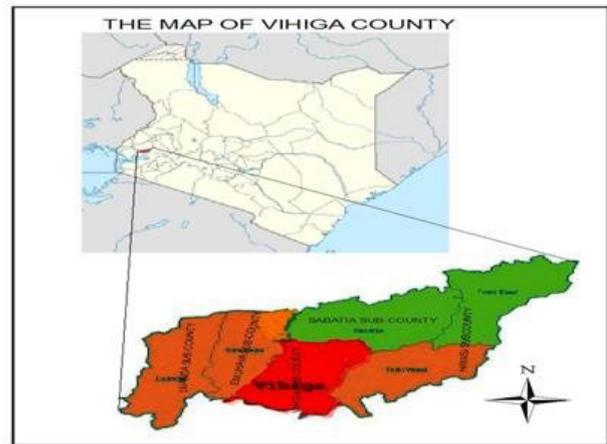


Figure 1. Map of Vihiga County

### 2.2 Study Design

Focus group discussion (FGD) with key informants was used to collect data on indigenous knowledge on harvesting and utilization of termites. The design enabled to get in-depth inquiry as well as have informed theory and practices.

### 2.3 Sampling and Sample Size

Purposive sampling was used to obtain 96 key informants drawn from household of farmers who had majored in quail farming and known to have knowledge on termite utilization. The number of interviewees was chosen based on percentage of farmers harvesting termites in accordance with Vasileiou [7] using Cochran's formula on determination of sample size since information on number of farmers harvesting termites was unknown.

Sample size (n)

$$no = \frac{Z^2 pq}{e^2}$$

Where

Confidence level=	95%
Precision =	0.1
no =	Sample size
p =	estimated proportion of an attribute that is present in a population
e =	desired level of precision
q =	1-p
no =	$\frac{1.96^2(0.5)(0.5)}{0.1^2}$
No =	96.04

## 2.4 Data Collection

Data were collected on farmer’s socio-demographic profiles, utilization of termites, termite species, termite habitats, and harvesting techniques. The pre-test was used to assess the ease of understanding of the questions by respondents and their appropriateness under the study context.

## 2.5 Data Analysis

Data analysis on descriptive statistics was done with the aid of the Statistical Package for Social Sciences (SPSS) Version 21.0.

## 3. Results

### 3.1 Socio-demographic Profile

Socio-demographic profile of respondents revealed that 70% of the community engaged in termite harvesting were male while only 30% were female. The most (55%) age group engaged in termite harvesting was between 36 to 55 years. This was followed by age group of between 18 to 35 years (25%), while the lowest was age group above 56 years (20%) (Table 1).

**Table 1.** Socio-demographic profiles of community engaged in termite harvesting in Vihiga County (n=96)

Variables	Categories	Response (%)
Gender	Male	70
	Female	30
Age	18-35	25
	36-55	55
	≥56	20

### 3.2 Termite Use

Most of the respondents (45%) indicated that the most common use of termites is as source of food, especially for the case of alates. Others (35%) indicated that termites such as soldiers and workers are used as feed especially for poultry. The rest of the respondents (20%) indicated that termites like queen are used to fatten young bulls (Table 2). Based on the importance of termites, most of the respondents (40%) indicated that they are mainly used as a cheap source of food or feed, while 20% of the respondents indicated that they are a rich source of nutrients. This was followed by 10% of the respondents who indicated that termites can help to improve taste of poultry meat, enhance quality of eggs or boost immunity of poultry. The lowest percentage of respondents (5%) indicated that termites are used for faster development of

poultry or improve growth and strength of bulls (Table 2).

**Table 2.** Termite use by community engaged in termite harvesting in Vihiga County (n=96)

Variables	Categories	Response (%)
Knowledge on use of termites	Soldiers and workers used to feed poultry	35
	Alates used as food	45
	Queen fed to young bulls	20
Importance of termites as feed/ food	Rich in nutrients	20
	Faster development of poultry	5
	Cheap source of food or feed	40
	Improve taste of poultry meat	10
	Improve growth and strength of bulls	5
	Enhance quality of eggs	10
	Boost immunity of poultry	10

### 3.3 Termite Species and Preference

Based on indigenous knowledge on existing termite species and their characteristic features, the respondents revealed that the alates of *pseudocanthotermes millitaris* and *Macrotermes bellicosus* were the most commonly known termite (40%) (Table 3). They indicated that the alates emerge as from noon on a sunny day following previous rain and at night respectively. The second commonly known termite was *Macrotermes subhyalinus* (25%) and *pseudocanthotermes spininger* (25%), which emerge in the evening. The least commonly known termite was *Coptotermes millitaris* (10%), that emerge anytime during light showers (Table 4). The reason for the preferred termite species as food or feed was because they are delicious (40%), while others (35%) preferred the termite species because they are abundant and the rest (25%) preferred termite species because they do not injure poultry especially chicks (Table 4).

**Table 3.** Summary table on available edible species by local name

No.	Scientific Name	Local Name
1	<i>Macrotermes bellicosus</i>	Mafendete
2	<i>Macrotermes subhyalinus</i>	Kitunda
3	<i>Pseudocanthotermes millitaris</i>	Chiisiisi
4	<i>Pseudocanthotermes spininger</i>	Maburi
5	<i>Coptotermes millitaris</i>	Mamke

### 3.4 Termite Habitat

Majority of the respondents indicated that soils with minimal or no disturbance are places where termites were most likely (45%) to be found. This was followed by well-drained soil (15%) and then along the roads (10%) or near water source (10%) (Table 6). Based on features used to

determine presence of termites, mounds were the most likely (45%) feature for the determination of presence of termites. This was followed by galleries (25%), then openings (15%) or tunnels (15%) (Table 6).

**Table 4.** Knowledge on existing termite types by community engaged in termite harvesting in Vihiga County (n=96)

Variables	Categories	Response (%)
Indigenous knowledge on existing termite types (local names) and characteristic features	<i>Coptermes millitaris</i> - alates emerge anytime on slight rain	40
	<i>Pseudocanthotermes millitaris</i> -alates emerge at noon in sunny day following previous rain	25
	<i>Macrotermes bellicosus</i> -alates emerge at night	25
	<i>Marcotermes subhyalinus</i> and <i>Pseudocanthotermes spiniger</i> -alates emerge in the evening	10
The reason for the most preferred termites as feed/ food	They are abundant and does not injure the poultry	25
	They are abundant	35
	Delicious	40

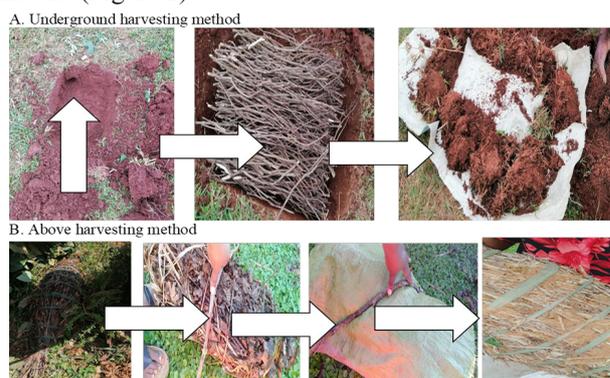
**Table 6.** Knowledge on places most likely to find termite by community engaged in termite harvesting in Vihiga County (n=96)

Variables	Categories	Response (%)
Places likely to find termites	Well-drained soil- <i>Pseudocanthotermes millitaris</i>	20
	Soils with little or no disturbance- <i>Pseudocanthotermes millitaris</i>	45
	Soils where no chemicals are used- <i>Pseudocanthotermes millitaris</i>	15
	Along the roads- <i>Macrotermes bellicosus</i> and <i>marcotermes Subhyalinus</i>	10
Features used to determine presence of termites	Near water source- <i>Coptotermes millitaris</i>	10
	Mounds ( <i>Macrotermes bellicosus</i> and <i>Macrotermes subhyalinus</i> )	45
	Galleries ( <i>Pseudocanthotermes millitaris</i> )	25
	Openings ( <i>Pseudocanthotermes millitaris</i> )	15
	Tunnels ( <i>Coptotermes millitaris</i> )	15

### 3.5 Termite Harvesting

Based on knowledge of termite harvesting, most

respondents (25% each) had termite harvesting experience of 11 to 20 years or 21 to 30 years. This was followed by less than 5 years or 5 to 10 years at 15% each and then those having termite harvesting experience of between 31 to 40 years and the lowest percentage (5% each) of respondents indicated that they had 41 to 50 years or over 50 years of termite harvesting experience (Table 7). Based on season for harvesting termites, majority (40%) reported that termites are mostly harvested during the rainy season particularly alates, followed by dry season (35%) and lastly 25% reported that they harvest termites throughout the day. Majority of the respondents reported that the best time of the day for harvesting termites was reported to be in the morning (45%). This was followed by respondents who indicated that termites can be harvested anytime of the day (25%), while 20% of the respondents indicated that termites are best harvested at noon and the rest (10%) of the respondents indicated that the best time of harvesting termites is evening. The most preferred termite harvesting method by the majority of the respondents (45%) use above ground, followed by below ground (30%), while the rest (25%) indicated digging through the mound (Figure 2).



**Figure 2.** Harvesting methods of termites

There were varied reasons on harvesting method of choice. Majority of farmers (30% each) preferred method of choice due to multiple harvest and high yields while 15% each indicated that the method was simpler and easy to separate termites from harvesting residuals materials but 10 percent attributed to ability of the method to capture a variety of termite species and caste (Table 7). Based on the materials used in the harvesting of termites, the most common one was the use of tea 30% maize stalk or cobs (20%), followed by use of dry couch grass (15%), Rattle weed (10%) cow dung (10%), dry eucalyptus back (5%), sugarcane (5%), others (5%). On preferred harvesting materials, farmers (35%) choose the material because of its ability to produce high, their reusability (20%), availability (15%), dry ability (15%), preferred by termites (10%), good trap (10%), attractants (5%).

**Table 7.** Knowledge on termite harvesting techniques by community engaged in termite harvesting in Vihiga County (n=96)

Variables	Categories	Response (%)	Variables	Categories	Response (%)
Experience on termite harvesting techniques (years)	<5	15	Why the preferred method	Simple and easier	15
	5-10	15		Multiple harvest	30
	11-20	25		Higher yield	30
	21-30	25		Captures variety of termites	10
	31-40	10		Easy to separate termites	15
	41-50	5			
Season for harvesting termites	>50	5	Materials used in the harvesting of termites	Dry eucalyptus back	5
	Throughout the year-solders and workers	25		Cow dung	10
	Rainy season- Riamke alates	40		Dry grass (couch grass)	15
	Dry season	35		Maize (stalk or cobs)	20
Best time of the day to harvest termites				Rattle weed	10
	Anytime	25		Tea (dry wood)	30
	Morning	45		Sugarcane	5
	Noon	20		Others	5
Harvesting method preferred	Evening	10	Why the preferred materials	Preferred by termites	10
	Above ground	45		Good trap (couch grass)	10
	Below ground	30		Availability	15
	Digging through mound	25		Attractants (cow dung)	5
				Reusability	20
				Drying ability	15
				Yield	35

#### 4. Discussion

The findings revealed that most edible termites' species in Western Kenya are subterranean termites. Termites are social insect that live in nest or colonies underground the soil whose society is highly integrated [8]. They are rarely seen above ground save for the period of flight for alates and workers during foraging whose presence is characterised by occasional galleries/ shelter tubes that appear on soil surface [8]. They prefer moist environment by leaving in soil or building of mud tunnels while foraging to prevent desiccation [8]. Farmers hence capitalise on the presence of galleries, mounds, and mud tunnels as appropriate bait site as well as guide in tracing the main nest. By composition, the caste termites obtained consisted of the winged termites known as alates (Chiiswa), and the wingless that consisted of soldiers (Tsindago) and workers (Amage). This conforms with subterranean type whose colony consist of a three-caste system of reproductive (consist of king, queen, alates, and nymph); soldiers and workers (pseudergates) with three forms of reproduction; primary, secondary and tertiary [8]. Reproductive males and females can be primary winged (alates/swarmer's) or secondary and tertiary that are wingless. The secondary and tertiary form a backup for the primary queen and king in case of death or injury. The workers forage for about 150 feet below and above ground in search of food by

making interconnected feeding site. The nature of mound, positioning of nest, emergence of alates together with morphological features of alates, worker and soldiers were used in combination to characterise the termites by genus and assigning of a local name.

On emergence of alates, it was reported that different species emerge at different seasons and time of the day throughout the calendar year. The *Macrotermes bellicosus* were particularly known to emerge during long rains as from April to June. The alates of the species are the biggest and mainly collected by farmers for use as food. They emerge at night for maximum period of one hour from 2.00 am to 3.00 am in the morning. The soldiers and workers of the same spp. are also the largest (soldier- 2 cm long) in comparison with other species. The soldier and workers were mainly harvested as described below (underground method) and directly fed to chicks and quails as suitable source of protein. Although there were reported cases of injury to the birds by soldiers, which hence informs on the need to identify appropriate method of administering the protein source to birds as well as ascertain its nutritive values and correct levels of inclusion. Features used to confirm the emergence of alates was by drop of feathers and presence of paired termites in readiness to form a new colony. The paired alate consist of male and female reproductive that such

for nest in suitable environment. The flight/emergence of alates are triggered by previous day's rain followed with dry warm spell.

The *Macrotermes subhylanus* were also identified as available and edible species in the region. Their presence is characterised by small and loosely build mound as their nest. In comparison, their mature mound of the spp. is smaller ( $\leq 0.5$  m) unlike the *Macrotermes bellicosus* whose mound is big ( $\geq 1$  m) and compact. In addition, the soldiers and workers of the species are the smallest of all the available edible termite species in the region. Farmers mainly collect the alates between 6:30 to 7.00 pm. whose period of emergence is the shortest. Farmers prefer the species attributing it to be sweeter with 50% of respondents consuming it in raw nature.

Beside the mounds as characteristics features the community mentioned the existence of galleries mud walls and openings on soil surface as confirmatory sign of the presence of both *Pseudocanthotermes millitaris* and *Pseudocanthotermes spiniger*. It was further mentioned that the nest for the two spp. could not easily be traced unlike the earlier discussed that had mounds of which the primary reproductive (both the king and queen) could easily be found. The alates of the two were used as food and soldiers and workers which were morphologically identical were harvested and used to feed for chicks and quails. Despite the quantities harvested, the soldiers and workers were preferred as direct feed to chicks since there were no reported incidences of injuries. On time of emergence, the alates for *pseudocanthotermes millitaris* emerge for about 2 hours on sunny day from noon 3.00 pm, following previous day's rain. For *Pseudocanthotermes subhyalinus*, the alates emerge for maximum period of 30 minutes in the evening as from 5.30 to 6 p.m again following previous days rain.

The last and fifth edible species identified was the *Coptotermes millitaris*. It was reported that the species is commonly found in cooler places near water sources. The major characteristic feature for their presence is several clustered open Tunnels ranging between 3 cm to 6 cm in diameter on which the termites make galleries. The presences of tunnels are indication of existence of nest underneath through which the primary reproductive termites (king and queen) are found. The alates are comparatively second biggest to *Marcotermes bellicosus* but greyish in colour. In addition, the alates emerge any time of the day during light showers. Their soldiers and workers have a light brown to cream head and mostly harvested by above method as described below. Most farmers the use of species as feed because of size and nutritive value a from fast growth rate of chicks and

desired taste of both meat and eggs. However, majority indicated that if used on small chicks ( $\leq 2$  weeks old), it affects performance which was evidenced from the mortality rate is very high. This calls for the need to ascertain on nutritive value of various termite species as well as the microbial load since quality of feed has direct impact to poultry and human.

From survey, it was observed that method, time and materials for collecting and harvesting of termite differ across caste and species. For alates light trapping is mainly used with trapping bait strategically placed at time of their emergence which also varies per species. The community used different source of light based on social economic status at night ranging from electric bulbs, bright torch, hurricane lamps to reflectors to harvest alates of *Macrotermes bellicosus* that emerge from mid night to 3.00 am. Natural sunlight is used to harvest *Macrotermes subhylanus* that emerge at different time of the day thus; 12:00 pm to 2. pm; 4:00 pm 5:00 pm; and 5:00 pm to 6:00 pm respectively where unidirectional light is provided with a pit trap at strategically positioned place. While for soldiers, there are two main methods. The mound excavation method that is proceeded by hand picking of soldiers and workers as described by <sup>[6]</sup> and baiting method which involve the underground and above ground harvesting techniques. It was observed that farmers prefer the baiting method unlike the excavation method which depends on availability of the mound alone and that the destruction of the termite nests and the entire colony makes it not effective and sustainable method as further observed in Burkina Faso <sup>[6]</sup>. For trapping method, dry wood of specific tree species were used as bait and in order of preference, tea was most preferred by respondent (30%) followed with maize stock (20%) rattle weed (10%) cow dung (10%) dry eucalyptus bark (5%) and others (5%). On choice of material the use of tea farmers reported of high yields and also it enabled recycling and reusability of the same material upon aeration for more than thrice. Maize stock gave the second highest yields but availability of the stalks is seasonal and that the material can only be used once. Couch grass similarly gave high yield but the community raised issue of availability in terms of quantities and inability to cultivate couch grass for use as harvesting material. On harvesting material application, was noted that each material could be used singly or in combination, but the yields increased upon slight addition of cow dung. The aspect of cow dung and organic material further points to study in Burkina Faso <sup>[6]</sup>. Knowledge of preference status is key in effective baiting since the response of termite species to bait depends on quality of wood in terms of moisture content, hardness,

presence and absence of resins and lignin<sup>[9]</sup>.

The choice of reported termite harvesting materials that consisted of plants of different tree species and organic compound points to cellulose, a compound that is most preferred by termites as informed by premise that, termites are detritivores organisms that mostly feed on dead plants at any level of decomposition<sup>[9]</sup>. They rely on symbiotic protozoa and other microbes in their hind gut which enhance fibre breakdown in cellulose. The choice of harvesting material by the community which from the highly ranked, dry tea wood (30%) to the least dry eucalyptus back of (5%) as feed material conform with previous studies on termites feeding habit on wood. In addition different plant species produce various secondary metabolite that attract insects in wood material<sup>[10]</sup>

On trapping method, for both underground and above method, the bait materials were placed at foraging site characterised by presence of galleries, openings and channels. For above ground method, the harvesting materials are tightly compacted together in a spindle shaped structure “Rifumbo” and firmly supported on ground by pegs followed with covering with twigs or polythene bag to mimic the natural habitat and prevent entry of water. Whereas for underground, a shallow hall measuring standard holes of 48 cm long, 15 cm wide and 10 cm deep were used throughout the harvesting process. The holes were filled with harvested material tightly compacted, sprinkled with cow dung then covered with water proof material before adding a thin layer of soil. For both cases harvesting was done the following day early in the morning by emptying the spindle structure together with termites in a collection container or by uncovering the water proof material and scoping the termites into a collection container based on method. The community prefers morning harvesting when termites are still foraging since high yields were realised when harvesting was done before 8 am. Extreme temperatures triggers the termites to migrate back into the subterranean<sup>[6]</sup>. This conforms to their behaviour of preferring warmth, moist and availability food<sup>[11]</sup>. For both methods, yields were directly dependent on distance from one whole/spindle to the next and from mound to baiting site. Despite the termite preference of couch grass, the material was soft rare and subject to depletion before morning harvesting. Termites are always attracted to food and upon its completion they move back into their nest<sup>[6]</sup>. It was hence recommendable to use harder but preferred in correct quantities for effective yield or mixture for maximum attraction and retention since yield were dependant on. In addition to use of wood, it was observed that the community sprinkled cow dung as an attractant in which

study in Burkina Faso had embraced on the placing of other organic compounds and cow dung in a pot to attract termites<sup>[6]</sup>. The recommended spacing of baiting material was further proposed to contribute to yields. The community proposed on least the use of 10 m for above method when using the spindle structure and inter hole spacing of 5 m apart for desired yields.

## 5. Conclusions

The five edible subterranean termites found and highly utilised as food and feed in western part of Western Kenya are *Macrotermes bellicosus*, *Macrotermes sublyhanus*, *Pseudocanthotermes millitaris* *Coptotermes Millitaris* *Pseudocanthotermes spiniger* *Macrotermes subhyalinus*.

In addition, there is no specific distinct habitat for termites found in the region. However, the key distinguishing feature per species is presence of either mound, galleries, mud walls and tunnels. The five species are preferred for use as feed or food based on taste, effect to birds and mortality to young chicks. Based on above findings, more research should be done to determine:

- ✓ The nutritive value of existing termite species
- ✓ best mode of utilisation and inclusion levels for better performance
- ✓ ascertain the biosafety of their use as food and feed

Lastly termites harvesting technique can effectively be enhanced through identification of suitable metabolites that are mainly attractant for synthesis of artificial pheromone that will assist in baiting.

## Acknowledgement

The study was funded by World Bank funded under The Africa Center of Excellence in Sustainable Use of Insects as Food and Feeds (INSEFOODS) at Jaramogi Oginga Odinga University of Science and Technology (JOOUST), Kenya.

## References

- [1] Kinyuru, J.N., Mogendi, J.B., Riwa, C.A., Ndung'u, N.W., 2015. Edible insects-A novel source of essential nutrients for human diet: Learning from traditional knowledge. *Anim Front.* 5(2), 14-9.
- [2] Obiero, K., Meulenbroek, P., Drexler, S., Dagne, A., Akoll, P., Odong, R., et al., 2019. The contribution of fish to food and nutrition security in Eastern Africa: Emerging trends and future outlooks. *Sustain.* 11(6), 1-15.
- [3] Amobi, M.I., Ebenebe, C.I., 2018. Quality of the carcass and organs of chicken fed with two different insects meals. *J Insects as Food Feed.* 4(4), 269-74.

- [4] Affedzie-obresi, S., March 2019. Use of Termites by Farmers as Poultry Feed in Ghana.
- [5] Sankara, F., Pousga, S., Dao, N.C.A., Gbemavo, D.S.J.C., Clottey, V.A., Coulibaly, K., et al, 2018. Indigenous knowledge and potential of termites as poultry feed in Burkina Faso Abstract. 1(1), 1-8.
- [6] Dao, A.N.C., Sankara, F., Pousga, S., Coulibaly, K., Nacoulma, J.P., Ouedraogo, S., et al., 2020. Traditional methods of harvesting termites used as poultry feed in Burkina Faso. *Int J Trop Insect Sci.* 40(1), 109-18.
- [7] Vasileiou, K., Barnett, J., Thorpe, S., Young, T., 2018. Characterising and justifying sample size sufficiency in interview-based studies: Systematic analysis of qualitative health research over a 15-year period. *BMC Med Res Methodol.* 18(1).
- [8] Lewis, V.R., Sutherland, A.M., Haverty, M.I., 2014. Subterranean and other termites. *Pest Notes.* (7415), 6.
- [9] Sell-kubiak, E., Wimmers, K., Szwaczkowski, T., February 2018. Review of strategies to improve feed efficiency and reduce environmental footprint in poultry Measures of feed efficiency traits and their heritability.
- [10] Beran, F., Köllner, T.G., Gershenzon, J., Tholl, D., 2019. Chemical convergence between plants and insects: biosynthetic origins and functions of common secondary metabolites. *New Phytol.* 223(1), 52-67.
- [11] Sekhar, C., Vidhyavathi, A., April 2018. Termites book. pp. 1-80.