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Ethnic heterogeneity of knowledge on termites and human consumption in southern Cameroon

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We thank the plant protection team for their help in the data collection.

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DATA NOTES

Ethnic Heterogeneity of Knowledge on Termites and Human Consumption in Southern Cameroon



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ABSTRACT

Termites are both pests and non-conventional food resources in Sub-Saharan Africa. Many are reluctant to eat them, and the reasons for this rejection are poorly known. This study examined level of knowledge, and acceptance by members of the 10 main ethnic groups of southern Cameroon. Most respondents (86 percent) were aware of termites as food with sixteen vernacular names in the study areas. Acceptance among ethnic groups for consumption varied between 96 percent and 8 percent of people in a group. Barriers included being raised to not eat termites, not having many opportunities to eat termites, and dislike of the taste.

INTRODUCTION

Demographic forecasts for the next 100 years show that famine and protein-energy malnutrition problems will not improve—especially for Africa, where the population may reach 4.2 billion people in 2100 (Leridon 2015). In this context, new sources of food are needed, and non-timber forest products of animal origin (e.g., insects) could be an alternative solution. Mushrooms, snails and insects have been shown to be non-timber forest products (NTFPs) of great im-

portance (Mbétid-Bessane 2005). Insects have significant advantages in terms of their nutritional value, accessibility, simple breeding and very rapid growth and reproduction rate (Rumpold and Schlüter 2013). Typically poorly exploited by humans, they could be an approach to a solution that offers cheap, effective and available opportunities to address food insecurity by providing high-quality, emergency protein sources that improve traditional diets (Van Huis et al. 2014). Some edible insects have higher protein, fat and energy levels than do meat and fish (DeFoliart 1992).

There are more than 1700 species of edible insects and the most widely consumed in the world belong to the following Orders: Lepidoptera, Orthoptera, Coleoptera, Isoptera, Homoptera, Hymenoptera and Dip-
 tera (Johnson 2010). In West and Central Africa, in-
 sects are not only used as emergency food during pe-
 riods of famine, but are an integral part of the normal
 diet of some peoples according to the periods of ap-
 pearance of different edible species during the year
 (Banjo et al. 2006). Studies in Uganda, Cameroon, Ni-
 geria and Côte d'Ivoire indicate termites are among
 the most widely consumed and appreciated insects by
 people on the African continent (Niaba et al. 2012,
 Adepoju and Omotayo 2014, Tamesse et al. 2016).

Termites—Order Isoptera—are widely distributed
 throughout the world, especially in the tropics
 (Eggleton et al. 1995, Bignell and Eggleton 2000).
 They are recognized as major pests of crops, build-
 ings, and furniture and annually cause billions of dol-
 lars of damages worldwide (Cowie et al. 1989, Logan
 et al. 1990, Ambele et al. 2018). They live in colonies
 and have a very specialized caste organization—alates,
 workers and soldiers—ensuring different functions
 for the maintenance of the colony and species (Bignell
 et al. 2011). Winged termites are known and con-
 sumed in both rural and urban areas (Tamesse et al.
 2016). They are mostly consumed for their good taste
 and medicinal properties (De Figueirêdo et al. 2015,
 Tamesse et al. 2016). Studies in Nigeria found ter-
 mites to be rich in proteins, vitamins (A, B2, and C),
 and minerals (calcium, phosphorus, iron, and magne-
 sium) (Banjo et al. 2006). They are also important
 sources of fatty acids such as palmitic, oleic, and lino-
 leic acids (Womeni et al. 2009).

Although much appreciated with numerous virtues,
 termites are not consumed by everyone, even in Sub-
 Saharan regions where they are appreciated by many
 groups (Niaba et al. 2012, Tamesse et al. 2016). Many
 studies have evaluated people's perception of ter-

mites, mainly for their role as pests (Sileshi et al. 2009,
 Loko et al. 2017, Ewetola et al. 2018). Less research
 has focused on their perception as edible insects
 (Tamesse et al. 2016, Akullo et al. 2017), and very lit-
 tle information is known about the consumer's ac-
 ceptance and non-acceptance of these insects as foods
 in Africa. Acceptance and non-acceptance vary among
 ethnic groups (Van Huis 2003). Cameroon is one of
 the world's most ethnically and culturally diverse
 countries (Fearon 2003). In order to highlight the rea-
 sons for use of termites in the southern Cameroon to
 combat poverty and famine in Africa, this study as-
 sessed different ethnic groups': 1) level of knowledge
 about termites, 2) level of acceptance of termites, and
 3) reasons for non-acceptance of termites.

METHODOLOGY

The Study Sites

The study took place in January and February, 2018,
 in the Centre, South and East regions of Cameroon
 (Figure 1). Ten sites were selected in these regions to
 represent the ten main ethnic groups: Ewondos
 (Mbankomo), Etons (Obala), Bafias (Bafia), Yambas-
 sas (Bokito), Bassas (Makak), Bulus (Ebolowa), Ntu-
 mus (Ambam), Pygmies (Djoum), Batangas (Kribi)
 and Makas (Abong-Mbang). For each ethnic group,
 the most populated village was selected (Santoir and
 Bouopda 1995). The main economic activity of all of
 these ethnic groups is the practice of slash-and-burn
 agriculture. The main food crops are banana (*Musa*
paradisiaca), banana-plantain (*Musa xparadisiaca*), coco-
 yam (*Xanthosoma sagittifolium*), cassava (*Manihot esculen-
 ta*), yam (*Discorea* spp.) and peanut (*Arachis hypogaea*).
 Cucurbits (*Cucumis sativus*), okra (*Abelmoschus esculentus*),
 vegetables (*Apiaceae*, *Alliaceae*, *Fabiaceae*, *Cucurbitaceae*
 etc.) and spices (*Capsicum annum*, *Curcuma longa*, *Zingiber*
officinale etc.) are secondary crops, while cocoa
 (*Theobroma cacao*) and coffee (*Coffea* spp.) are the main
 cash crops in these areas.

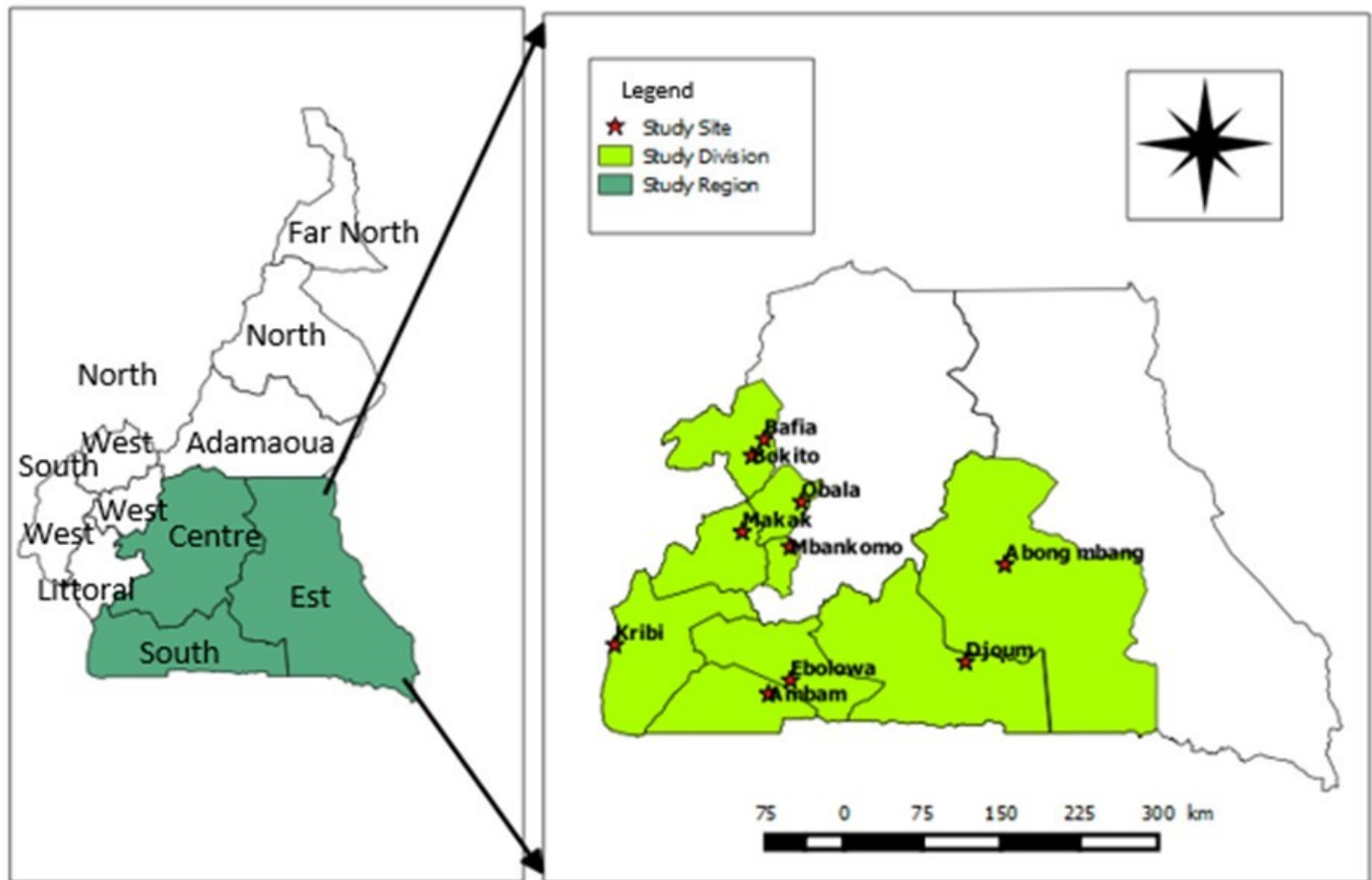


Figure 1. Map of the study sites (NIC 2017; Kekeunou et al. 2020)

In terms of eating habits, the Bulu, Eton and Ewondo consume respectively **ndo'o**, **okok** and **kwen** sauces from leaves and roots of vegetables and crops like cassava and peanut (Kekeunou et al. 2006). These ethnic groups' sites were all situated between 2 and 5 degrees latitude north. This zone is influenced by an equatorial Guinean climate with four seasons: long dry season (mid-November to mid-March); short rainy season (mid-March to June); short dry season (July to August) and long rainy season (September to mid-November). The temperature is between 22 and 29 degrees Celsius. The warm and very rainy equatorial climate has led to the alteration of the original rock material towards a ferrallitic type pedogenesis where all the elements of the source rock are hydrolyzed. Residual components (e.g., quartz, kaolinite, iron hydroxide) form the bulk of the soil. This results in soils with low mineral levels but whose physical characteristics

are good when clay content is good (Santoir and Bopda 1995).

Data Collection

Teams used a cross-sectional survey with individuals in each sample village, and a semi-structured questionnaire for discussions occurred with people from different ethnic groups. A total of 501 people (about 50 per ethnic group) were interviewed in total. The samples consisted of 47 percent men and 53 percent women. In each village, respondents were randomly selected following random routes (Bauer 2014). Participants were 15-85 years old (average 36 ± 16 for men, 35 ± 15 for women). The most represented age group was 20-30 years—comprising 33 percent of survey respondents. Single individuals were the most represented (38 percent), and most of them (37 per-

cent) were self-employed. The questionnaire, in French, was divided into four sections composed of 27 questions relating to socio-demographics, knowledge of termites, and reasons for acceptance and non-acceptance of termites. An image of the insect was presented at the beginning of each interview to the respondent in order to facilitate its recognition.

Data Analysis

The collected data were entered and stored in the Microsoft Excel version 2010 software and analyzed using the SPSS software version 20.0. The frequencies of responses to each question were calculated in relation to the number of respondents to the question.

RESULTS

Termite Knowledge in Southern Cameroon

Most surveyed knew termites as food (87 percent). However, as many people who knew termites amongst the Bulus as did not. Termite knowledge was different between the different ethnic groups (Table 1). Termites were known under 16 vernacular names (Figure 2), with *beb* (Bafias), *afabadoundouk* (Ntumus), *bandi* (Pygmies), *bédédé* (Batangas), *sil* (Etons) and *som-*

bo'o (Bassas) most common. The name *si/* was common to the Ewondos, Etons and Bulus.

The places of capture of edible termites varied from one ethnic group to another (Table 2). Generally, mounds were the first places of capture of the edible termites followed by houses. Pygmies capture termites mostly in forests.

For the periods of harvest, termites were captured throughout the day—especially in the mornings and evenings (Table 3). Captures were mainly in the evening among the Batangas, Ntumus, Ewondos, Bassas and Makas. Captures were more frequent in the mornings among the Pygmies and the Etons.

For the main periods of harvest, 63 percent (250 respondents) said that termites were abundant during the short rainy season (Table 4), although that opinion was not evenly distributed between the different ethnic groups. For instance, the Ntumus, Pygmies and Makas collected more termites during the long rainy season. There were many termite harvesting methods, including nets, light traps, manual picking, basins/ buckets filled with water, holes, bowls, and baskets. Traps employing bright lights and manual collection were the most commonly used methods for capture.

Table 1. Level of knowledge of termites as food in 10 ethnic groups of southern Cameroon (percent per group)

Ethnic group	Yes	No	Total
<i>Bafia</i>	100 (52)	0 (0)	100 (52)
<i>Batanga</i>	65 (31)	35 (17)	100 (48)
<i>Eton</i>	100 (58)	0 (0)	100 (58)
<i>Bulu</i>	58 (36)	42 (26)	100 (62)
<i>Ntumu</i>	83 (39)	17 (8)	100 (47)
<i>Ewondo</i>	98 (50)	2 (1)	100 (51)
<i>Bassa</i>	76 (41)	24 (13)	100 (54)
<i>Pygmies</i>	100 (31)	0 (0)	100 (31)
<i>Maka</i>	94 (48)	6 (3)	100 (51)
<i>Yambassa</i>	100 (47)	0 (0)	100 (47)
General mean	86 (433)	14 (68)	100 (501)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were mutually exclusive and people reported only yes or no as response.

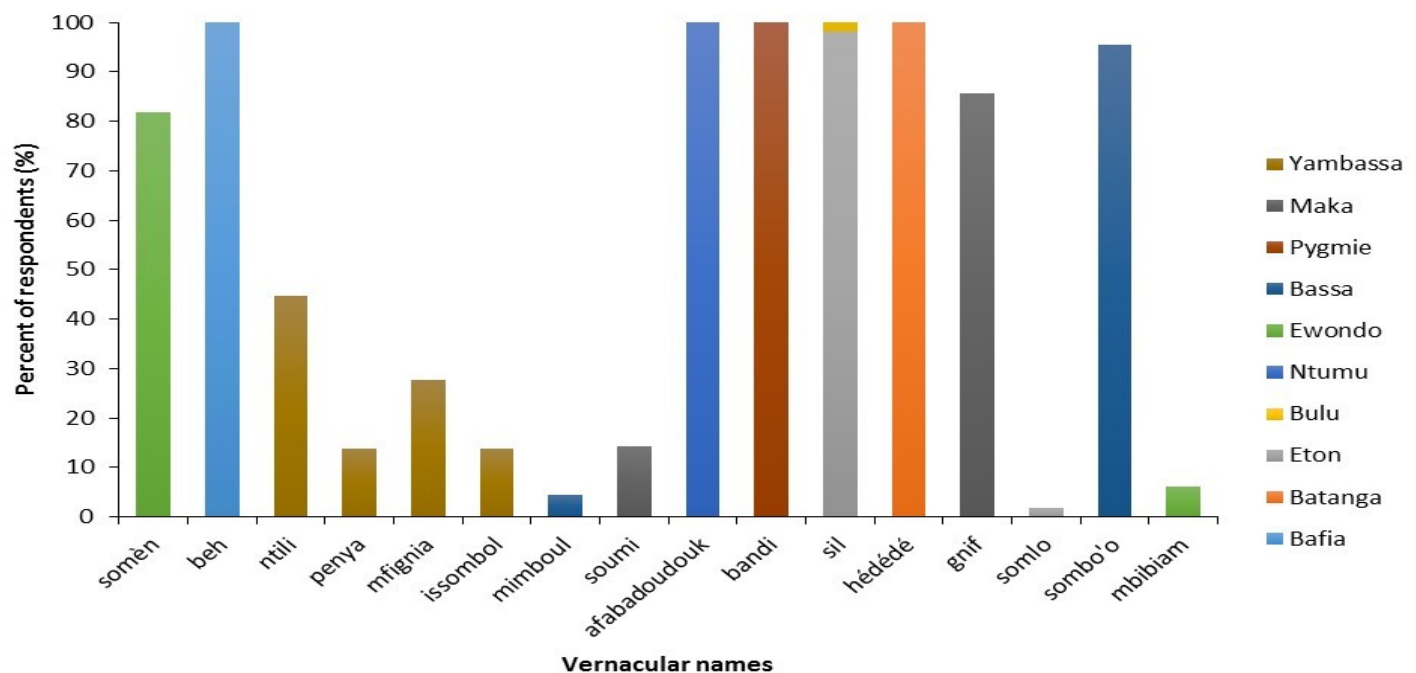


Figure 2. Vernacular termite names and their signaling frequencies in each ethnic group of Southern Cameroon.

Reasons for the Acceptance of Termites as Food

Food is the main reason for termite use in southern Cameroon (63 percent; Table 5), and the trend was the same among the ethnic groups. People consumed termites for several reasons (Table 6) including: good taste, high nutritional value, and cultural values. Taste was the main reason for termite consumption in all groups except Batangas, Bulus, Ntumus and Bassas.

Respondents consumed termites in different forms (Table 7). The fried form was the most common, followed by the grilled form, and by consumption in cakes. For the Bassas, Makas and Yambassas, termite consumption was preferably in the grilled form. Winged termites and soldiers were the only termite castes consumed by people in Southern Cameroon: all groups consumed winged termites, and only a few consumed soldiers.

Table 2. Places of capture of termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Place	Farms	Forest	Fallows	Houses	Markets	Soil	Water	Lampposts	Mounts	Total
<i>Bafia</i>	35 (18)	14 (7)	0 (0)	19 (10)	0 (0)	2 (1)	0 (0)	12 (6)	71 (37)	100 (52)
<i>Batanga</i>	7 (2)	0 (0)	0 (0)	52 (16)	16 (5)	0 (0)	0 (0)	29 (9)	10 (3)	100 (31)
<i>Eton</i>	22 (13)	0 (0)	0 (0)	17 (10)	0 (0)	0 (0)	0 (0)	16 (9)	88 (51)	100 (58)
<i>Bulu</i>	9 (3)	11 (4)	0 (0)	14 (5)	26 (9)	11 (4)	0 (0)	23 (8)	29 (10)	100 (35)
<i>Ntumu</i>	21 (8)	0 (0)	0 (0)	59 (23)	5 (2)	13 (5)	0 (0)	23 (9)	16 (6)	100 (39)
<i>Ewondo</i>	36 (18)	0 (0)	2 (1)	40 (20)	8 (4)	2 (1)	0 (0)	28 (14)	28 (14)	100 (50)
<i>Bassa</i>	20 (8)	5 (2)	0 (0)	15 (6)	13 (5)	3 (1)	0 (0)	18 (7)	45 (18)	100 (40)
<i>Pygmies</i>	7 (2)	81 (25)	0 (0)	10 (3)	0 (0)	3 (1)	0 (0)	0 (0)	55 (17)	100 (31)
<i>Maka</i>	10 (5)	6 (3)	0 (0)	6 (3)	2 (1)	35 (17)	2 (1)	25 (12)	48 (23)	100 (48)
<i>Yambassa</i>	28 (13)	4 (2)	0 (0)	32 (15)	0 (0)	0 (0)	0 (0)	13 (6)	66 (31)	100 (47)
General mean	21 (90)	10 (43)	1 (1)	26 (112)	6 (26)	7 (30)	1 (1)	19 (80)	49 (210)	100 (431)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

People consumed various quantities of termites daily: a spoonful, a handful, a glass or a cup (Table 8). However, most respondents said they consumed whatever quantity of termites and whenever available to them.

Methods of Cooking Termites

Almost half of the people interviewed knew about specific methods of cooking termites. The Bafias, Etons, Ewondos and pygmies were the main ethnic groups who cook termites. We identified eight termite cooking methods in the three regions (Table 9). In all

methods, a preliminary cleaning consists of removing non-digestible parts of the insect, such as wings. Most respondents who prepared termites used method 6 (45 percent)—used in all ethnic groups except the Ntumus, Bassas, and the Pygmies. Others preferred method 2 (25 percent) and method 4 (22 percent).

Reasons for the Rejection of Termites as Food

Despite the high level of termite consumption in southern Cameroon, some individuals disliked termites for different reasons (Table 10). Cultural barriers

Table 3. Periods of Harvest of termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	Period				Total
	Morning	Afternoon	Evening	Whole day	
<i>Bafia</i>	50 (26)	2 (1)	56 (29)	12 (6)	100 (52)
<i>Batanga</i>	27 (6)	0 (0)	59 (13)	23 (5)	100 (22)
<i>Eton</i>	88 (51)	0 (0)	12 (7)	3 (2)	100 (58)
<i>Bulu</i>	43 (9)	0 (0)	48 (10)	14 (3)	100 (21)
<i>Ntumu</i>	27 (9)	3 (1)	58 (19)	24 (8)	100 (33)
<i>Ewondo</i>	36 (16)	0 (0)	55 (24)	16 (7)	100 (44)
<i>Bassa</i>	27 (8)	3 (1)	63 (19)	20 (6)	100 (30)
<i>Pygmies</i>	43 (12)	7 (2)	7 (2)	43 (12)	100 (28)
<i>Maka</i>	18 (8)	2 (1)	61 (27)	25 (11)	100 (44)
<i>Yambassa</i>	68 (32)	0 (0)	43 (20)	8 (4)	100 (47)
General mean	47 (177)	2 (6)	45 (170)	17 (64)	100 (379)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

Table 4. Seasons of harvest of termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	Throughout the year	Short dry season	Short rainy season	Long dry season	Long rainy season	Total
<i>Bafia</i>	0 (0)	2 (1)	89 (46)	4 (2)	6 (3)	100 (52)
<i>Batanga</i>	0 (0)	4 (1)	63 (15)	13 (3)	25 (6)	100 (24)
<i>Eton</i>	0 (0)	0 (0)	83 (48)	0 (0)	17 (10)	100 (58)
<i>Bulu</i>	4 (1)	21 (5)	42 (10)	21 (5)	21 (5)	100 (24)
<i>Ntumu</i>	0 (0)	3 (1)	46 (17)	14 (5)	54 (20)	100 (38)
<i>Ewondo</i>	4 (2)	11 (5)	53 (25)	13 (6)	28 (13)	100 (47)
<i>Bassa</i>	0 (0)	10 (3)	81 (25)	3 (1)	7 (2)	100 (31)
<i>Pygmies</i>	7 (2)	7 (2)	19 (6)	7 (2)	61 (19)	100 (31)
<i>Maka</i>	4 (2)	9 (4)	39 (18)	2 (1)	57 (26)	100 (46)
<i>Yambassa</i>	0 (0)	4 (2)	85 (40)	0 (0)	11 (5)	100 (47)
General mean	2 (7)	-6 (24)	63 (250)	6 (25)	28 (109)	100 (398)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

ers and the bad taste of termites were the main reasons. Respondents of different ethnic groups said eating termites was as an ancestral habit. Many who do not eat termites reported that eating insects or specifically termites is an aberrant practice—justifying their response with the fact that their ancestors never considered insects as food:

I don't eat termites because never in my family lineage or in my ancestors' feeding practices have I heard about eating termites. Eating insects is not part of our culture (Bulu respondent).

Eating termites in our culture is comparable to eating cockroaches or worms, it is disgusting! My people don't practice such obscenity, and we prefer to eat meat (Batanga respondent).

Cultural barriers hindered termite use among the Ntumu and Batangas. Those who chose to eat termites were encouraged by friends in other ethnic groups without cultural barriers:

I never considered eating termites before because this practice is not well seen in my culture. But when some friends of mine,

Table 5. Main uses of termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	Consumption	Medicine	Trade value	Happiness prediction	Total
<i>Bafia</i>	96 (50)	0 (0)	0 (0)	0 (0)	100 (52)
<i>Batanga</i>	23 (7)	0 (0)	0 (0)	1 (2)	100 (31)
<i>Eton</i>	95 (55)	2 (1)	0 (0)	0 (0)	100 (58)
<i>Bulu</i>	42 (15)	0 (0)	0 (0)	0 (0)	100 (36)
<i>Ntumu</i>	8 (3)	0 (0)	0 (0)	0 (0)	100 (39)
<i>Ewondo</i>	78 (39)	3 (1)	3 (1)	5 (2)	100 (50)
<i>Bassa</i>	34 (14)	0 (0)	0 (0)	0 (0)	100 (41)
<i>Pygmée</i>	74 (23)	0 (0)	0 (0)	0 (0)	100 (31)
<i>Maka</i>	79 (38)	0 (0)	0 (0)	0 (0)	100 (48)
<i>Yambassa</i>	64 (30)	3 (9)	0 (0)	0 (0)	100 (47)
General mean	63 (274)	1 (3)	1 (1)	1 (4)	100 (433)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

Table 6. Reasons for consuming termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	Reason							Total
	High nutritive value	Therapeutic virtues	Good taste	Part of culture	Part of eating habit	Natural food	Curiosity	
<i>Bafia</i>	40 (21)	0 (0)	73 (38)	62 (32)	0 (0)	2 (1)	0 (0)	100 (52)
<i>Batanga</i>	3 (1)	0 (0)	23 (7)	3 (1)	0 (0)	0 (0)	13 (4)	100 (31)
<i>Eton</i>	67 (39)	2 (1)	71 (41)	40 (23)	3 (2)	7 (4)	0 (0)	100 (58)
<i>Bulu</i>	6 (2)	0 (0)	30 (11)	0 (0)	0 (0)	0 (0)	22 (8)	100 (36)
<i>Ntumu</i>	5 (2)	0 (0)	8 (3)	0 (0)	0 (0)	0 (0)	0 (0)	100 (39)
<i>Ewondo</i>	54 (27)	0 (0)	60 (30)	12 (6)	0 (0)	4 (2)	0 (0)	100 (50)
<i>Bassa</i>	24 (10)	0 (0)	29 (12)	7 (3)	0 (0)	0 (0)	2 (1)	100 (41)
<i>Pygmies</i>	26 (8)	0 (0)	68 (21)	71 (22)	3 (1)	0 (0)	0 (0)	100 (31)
<i>Maka</i>	10 (5)	0 (0)	71 (34)	15 (7)	25 (12)	2 (1)	8 (4)	100 (48)
<i>Yambassa</i>	36 (17)	0 (0)	62 (29)	34 (16)	0 (0)	2 (1)	0 (0)	100 (47)
General mean	31 (132)	1 (1)	52 (226)	25 (110)	4 (15)	2 (9)	4 (17)	100 (433)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

especially the Etons, shared with me their meal of termites, I felt in love with termites because it was very delicious (Batanga respondent).

In the Bassas' biophysical environment, edible termites are scarce. They do not consider termites an alternative food—but they are not against the practice of eating insects. Bad taste was the main reason for termite refusal among the Bulus, Ewondos, Pygmies, and Yambassas.

DISCUSSION

Termites are well known to the ethnic groups of southern Cameroon probably because it is an edible insect. The knowledge of termites as food in sub-Saharan Africa has been reported by several authors cited by Fombong and Kinyuru (2018). In fact, termite popularity is not only due to their fatty acid (44.8–47.3 g/100 g) and protein content (33.5–39.7 g/100g dry weight) (Fombong and Kinyuru 2018),

Table 7. Forms of consumption of termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	Form of consumption						Total
	In soup	Fried	braised	Raw	Grilled	In cake	
<i>Bafia</i>	0 (0)	85 (41)	0 (0)	13 (6)	19 (8)	40 (19)	100 (48)
<i>Batanga</i>	14 (1)	100 (7)	0 (0)	14 (1)	14 (1)	14 (1)	100 (7)
<i>Eton</i>	7 (4)	80 (44)	2 (1)	6 (3)	24 (13)	66 (36)	100 (54)
<i>Bulu</i>	7 (1)	60 (9)	0 (0)	0 (0)	33 (5)	0 (0)	100 (15)
<i>Ntumu</i>	0 (0)	67 (2)	0 (0)	0 (0)	33 (1)	0 (0)	100 (3)
<i>Ewondo</i>	5 (2)	84 (36)	2 (1)	5 (2)	2 (1)	21 (9)	100 (43)
<i>Bassa</i>	7 (1)	50 (7)	0 (0)	7 (1)	57 (8)	14 (2)	100 (14)
<i>Pygmies</i>	9 (2)	83 (19)	0 (0)	35 (8)	9 (2)	9 (2)	100 (23)
<i>Maka</i>	3 (1)	42 (16)	0 (0)	0 (0)	76 (29)	8 (3)	100 (38)
<i>Yambassa</i>	7 (2)	43 (13)	0 (0)	3 (1)	53 (16)	27 (8)	100 (30)
General mean	5 (14)	70 (190)	1 (2)	8 (22)	31 (85)	30 (80)	100 (275)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

Table 8. Termite quantities consumed daily in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	Quantity consumed per day					Total
	Spoonful	Handful	Glass	Cup	Available quantity	
<i>Bafia</i>	8 (4)	31 (15)	25 (12)	0 (0)	33 (16)	100 (48)
<i>Batanga</i>	14 (1)	29 (2)	29 (2)	0 (0)	29 (2)	100 (7)
<i>Eton</i>	9 (5)	27 (15)	5 (3)	0 (0)	58 (32)	100 (55)
<i>Bulu</i>	47 (7)	20 (3)	20 (3)	7 (1)	7 (1)	100 (15)
<i>Ntumu</i>	0 (0)	0 (0)	67 (2)	0 (0)	33 (1)	100 (3)
<i>Ewondo</i>	8 (3)	45 (17)	13 (5)	13 (5)	21 (8)	100 (38)
<i>Bassa</i>	14 (2)	43 (6)	0 (0)	7 (1)	36 (5)	100 (14)
<i>Pygmies</i>	0 (0)	9 (2)	9 (2)	4 (1)	78 (18)	100 (23)
<i>Maka</i>	10 (4)	37 (14)	3 (1)	3 (1)	47 (18)	100 (38)
<i>Yambassa</i>	13 (4)	57 (17)	3 (1)	0 (0)	23 (7)	100 (30)
General mean	11 (30)	34 (91)	11 (31)	3 (9)	40 (108)	100 (271)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

but also because of their crop pest status and their relatively intertropical zone ubiquity (Eggleton et al. 1995, Bignell and Eggleton 2000, Bignell et al. 2011).

Most ethnic groups had a vernacular name for each termite species (see Loko et al. 2017 for Benin). In general, knowledge of insects in the ancestral lineage propagates different vernacular names in association with cultural and linguistic diversity. Similar names appearing across ethnic groups may indicate phylogenetic linguistic relationships. For example, the Ewondos, Etons and Bulus use the name **sil** for termites and are grouped as the upper Betis ethnic group.

Traditionally, in African societies, animal naming was usually based on local criteria potentially related to the activities, functions, and uses of the species by the people. In Nepal, the praying mantis (order *Mantodea*)—although harmless and beneficial—was named after its alleged habit of pulling out people's eyes (Gurung-Björnsen 2003). Such insect naming justifies the exist-

ence of local taxonomy. This local taxonomy of edible insects may be of help to nutritionists and biologists for the easily recognizing a species of interest.

Variation in place and time of termite capture according to the ethnicity is related to the fact that different termite species are used. The termite species depends on the type of vegetation, the soil and climatic conditions. For example, among edible termites, the *Macrotermes* spp. prefer disturbed environments whereas the *Cubitermes* spp. prefer forest underwood (Eggleton et al. 2002). The Bafias and Yambassas live in the savannas; the Etons are in a forest-savannah ecotone while the Ntumus, Bulus and Pygmies inhabit the forest areas. Fombong and Kinyuru (2018) also noticed—like we have—that termites are attracted by light.

The winged adults are the most consumed stage because of their swarming habits during nuptial flights to establish new colonies, especially after rainfalls. They usually shed their wings after such flights, thus making them easily available for harvest (Fombong

Table 9. Methods of Cooking of termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	1. Clean, boil and fry termites with oil and spices	2. Clean and fry termites with little oil and spices	3. Wash termites with hot water and fry	4. Clean termites, crush, and mix with pistachio or peanut cakes	5. Grill termites to remove wings; fry with oil and spices	6. Clean and fry termites with spices but no oil	7. Clean termites, put them whole into peanut or pistachio cakes	8. Clean, boil and fry termites without oil	Total
Bafia	20 (6)	24 (7)	0 (0)	24 (7)	0 (0)	55 (16)	3 (1)	0 (0)	100 (30)
Batanga	0 (0)	25 (1)	0 (0)	0 (0)	0 (0)	50 (2)	25 (1)	0 (0)	100 (4)
Eton	2 (1)	23 (11)	0 (0)	44 (21)	0 (0)	63 (30)	0 (0)	2 (1)	100 (48)
Bulu	50 (1)	0 (0)	0 (0)	50 (1)	0 (0)	50 (1)	0 (0)	0 (0)	100 (2)
Ntumu	0 (0)	100 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	100 (1)
Ewondo	7 (2)	56 (15)	7 (2)	4 (1)	4 (1)	18 (5)	7 (2)	0 (0)	100 (28)
Bassa	0 (0)	17 (1)	50 (3)	0 (0)	67 (4)	0 (0)	0 (0)	0 (0)	100 (6)
Pygmies	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	100 (19)	100 (19)
Maka	0 (0)	25 (5)	0 (0)	5 (1)	0 (0)	65 (13)	0 (0)	10 (2)	100 (20)
Yambassa	7 (1)	14 (2)	0 (0)	29 (4)	0 (0)	36 (5)	29(4)	0 (0)	100 (14)
Mean	6 (11)	25 (43)	1 (2)	22 (38)	1 (1)	45 (77)	5 (8)	13 (22)	100 (172)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

and Kinyuru 2018). The soldiers are also eaten, but they are mostly harvested from the mound itself by making holes and sending in twigs or sticks to get them out (Van Huis 2017, Fombong and Kinyuru 2018).

Termites are widely consumed by people around the world and are the second most consumed insects after locusts (De Figueirêdo et al. 2015). Termites are widely distributed in Cameroon with nearly 100 species recorded, some edible (Dibog et al. 1998). The level of consumption of termites in our study (63 percent) was higher than 46 percent obtained in Ghana (Anankware et al. 2016), but lower than 70 percent in Cameroon (Tamesse et al. 2016), 76 percent in Ivory Coast (Niaba et al. 2012) and 97 percent in Uganda (Akullo et al. 2017) for the sampled populations.

The most commonly consumed termite species, *Macrotermes*, are mainly savannah species rare in low disturbance area like forests (Eggleton et al. 2002), hence hindering consumption by many indigenous populations. This is why the Bassa ethnic group complained about scarcity of edible termites in their forested environment. Consumption of termites in southern Cameroon is mainly due to taste (see also Tamesse et al.

2016), and Niaba et al. (2012) also found taste as the main reason for termite consumption in Côte d'Ivoire.

The study also revealed that 70 percent of the people in southern Cameroon consume termites in fried form (similar to Tamesse et al. 2016 in Cameroon, and Niaba et al. 2012 in Côte d'Ivoire). The consumption of fried termites is not an uncommon practice in entomophagy, because it has been reported in other insects such as the grasshopper *Zonocerus variegatus* (Kekeunou and Tamesse 2016, Fombong and Kinyuru 2018) and cockchafers/doodlebugs (*Melolontha* spp.) (Womeni et al. 2009). This form of cooking optimizes the taste and reduces the cost of cooking, as the insect is fried in its own oil, while preserving its nutritional value (proteins and minerals of the insect). However, very little data are available on this subject, and it therefore requires a detailed study.

The method of cooking food is an element of cultural identity that can explain the plurality of methods noted in southern Cameroon. In this study, there are several methods of cooking but none of the ethnic groups eat raw termites. Cleaning, as reported by the respondents, is an ancestral practice which involves the removal of the parts of the insect that are non-

Table 10. Reasons for the non-acceptance (rejection) of termites in 10 ethnic groups of southern Cameroon (percent per ethnic group)

Ethnic group	Reason				Total
	Cultural barrier	Not part of eating habit	Scarcity of edible termites in the locality	Bad taste	
Bafia	2 (1)	0 (0)	0 (0)	3 (2)	100 (52)
Batanga	58 (18)	6 (2)	6 (2)	10 (1)	100 (31)
Eton	0 (0)	3 (2)	0 (0)	3 (2)	100 (58)
Bulu	8 (3)	17 (6)	3 (1)	31 (11)	100 (36)
Ntumu	92 (36)	0 (0)	0 (0)	0 (0)	100 (39)
Ewondo	0 (0)	4 (2)	2 (1)	18 (9)	100 (50)
Bassa	20 (8)	15 (6)	29 (12)	2 (1)	100 (41)
Pygmies	0 (0)	0 (0)	0 (0)	26 (8)	100 (31)
Maka	0 (0)	4 (2)	0 (0)	15 (7)	100 (48)
Yambassa	4 (2)	4 (2)	0 (0)	29 (14)	100 (47)
General mean	16 (68)	5 (22)	4 (16)	13 (56)	100 (433)

Values in table refer to the percentage of respondents per ethnic group and values in parentheses refer to the number of respondents. The answers obtained in this table were not mutually exclusive and people can report more than one response.

digestible by humans especially the wings, in order to optimize nutrients absorption (Johnson 2010). The same practice was reported in other insects such as grasshoppers (Idowu and Modder 1996). The use of the fatty mass of the insect gives a double advantage: 1) the fatty parts are transformed into substances that are easily assimilated by the body under the effect of heat, and 2) its cooking does not require additional supply of oil; hence, it is a significant economic benefit. Use of spices, highly valued in human nutrition, improves the flavor of the food alongside their important metabolic, antimicrobial and chemopreventive roles to the body (Lai and Roy 2004, Srinivasan 2005). This minimal processing is usually necessary to ensure safe consumption of products, though it decreases digestibility and availability of some micronutrients (Fombong and Kinyuru 2018).

The main reason for people rejecting termites in southern Cameroon was cultural barriers. These barriers are associated with the ancestral heritage of not considering termites or insects as food. These people do not eat termites because of their feelings or understandings of *what they think these insects are*. When some individuals have an opportunity to taste termites, they discover their prior beliefs and/or knowledge about termites are not very useful to them.

Children are taught at a young age what not to eat (Rozin and Vollmecke 1986), and also learn to like specific foods through exposure and social learning (Nicklaus and Issanchou 2006). This results in the rejection of some foods by people based on what they think of the food as non-edible. In terms of global aspects of local diets, the influence of Western societies on the feeding habits of African societies is not negligible. This is seen in young Africans who like to imitate Western habits in their social learning and thus turn against ancestral entomophagy (Van Huis 2003). Knowledge about the taste and usage of a food item are limited when prior experience or data is absent.

CONCLUSION

This study revealed that people interviewed in Southern Cameroon are very familiar with termites, and that this knowledge varies somewhat according to ethnic group. Termites were highly consumed in the study area mainly due to their good taste, and were cooked with various methods. Despite the reported high nutritional value of termites, cultural barriers via tradition hindered their acceptance as food by some people within the ethnic groups surveyed. These insects, with important nutritional values, could be promoted to encourage their consumption in Africa and elsewhere, in order to fight against the growing food insecurity and poverty.

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