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RESEARCH ARTICLE

FOOD USAGE OF *MACROTERMES* (ISOPTERA, TERMITIDAE) ALATES IN LOME (SOUTHERN TOGO)

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Abstract

The consumption of insect including termites is gaining more interest nowadays even though many people still ignore the great benefit of enthomophagy. This study is a contribution to the valorization of *Macrotermes*alates in Lomé (southern Togo). For this purpose, a survey was carried out in three municipalities of Golfe 3, Golfe 7 and Agoè-Nyivé 1; (all located in the district of Lomé) from June 14 to July 14, 2021. A total of 345 people were submitted to a set of questionary to assess the level of their knowledge and consequences related to the consumption of *Macrotermes* alates. The results revealed that more than 94% of the participants not only had a good knowledge of *Macrotermes* alates, but have also consumed them. Among the surveyed people, 48.67% consumed these alates for their taste while 28.67% consumed them for their nutritional value. Also, 43.70% of participants who had once consumed these alates, stated that they experienced gastrointestinal troubles following the consumption. Thus, although it is important to encourage the consumption of *Macrotermes* alates, hygienic precautions should be taken during the collection and processing of these alates in the interest of the health safety of consumers.

Introduction:-

Insects are a food resource whose contribution to food security is becoming increasingly evident. Insect consumption or enthomophagy is actually widely observed in tropical and subtropical areas (Kent, 2002). Indeed, more than 1400 species of insects are regularly consumed in Asia, Latin America and sub-Saharan countries by nearly 2.5 billion people (Sodjinou et al., 2002; Allotey&Mpuchane, 2003; Malaisse, 2004). In the Republic of Congo, for example, caterpillars are consumed at about 30 g per day per person between July and August each year (N'kouka, 1987). These caterpillars are consumed entirely and thus represent a common dish for 85% of the population in the Central African Republic, 70% in the Democratic Republic of Congo and 91% in Botswana (Mbétid, 2005). In Kenya, lake Victoria communities encourage the consumption of termite alates by children and pregnant women because of their nutritional value (Kinyuru et al., 2009). Indeed, termites such as many other insects are not only important sources of protein and fat, but also are rich in minerals (Niaba, 2014). According to

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the Food and Agriculture Organization (FAO), the nutritional quality of larvae and other insects could contribute to ensure the global food security in the coming decades (Saunders, 2008; Ekpo et al., 2009). Promoting the consumption of edible insects could then be a source of improvement in protein-poor diets (Defoliart, 1992). Alates of *Macrotermes*,like several edible insects, are often eaten raw or fried, usually as part of a complete meal or not. As part of a meal, they are often mixed with tapioca or grilled corn and used as sandwich with bread in Nigeria (Banjo et al., 2006). The alates are caught at dusk and night, either by hand or with the help of cages and torches. Once caught, they are usually dried directly in the sun or slightly roasted (Ekpo, 2007). Although rich in nutrients, this food resource is not enough valorized in Sub-Saharan countries including Togo where the population even tends to abandon it (Badanaro et al., 2014). It is therefore necessary to determine the cause of repugnancy and valorize the consumption of *Macrotermes* alates in Togo, as a non-conventional food resource. Thus, the aim of this study is to assess the level of knowledge on food usage of *Macrotermes*alates and their repugnancy in three municipalites of Lomé district.

Materials And Methods:-

Study sites

This study was carried out in the municipalities of Agoè-Nyivé 1, Golfe 3 and Golfe 7 all included in the district of Lomé (Figure 1).

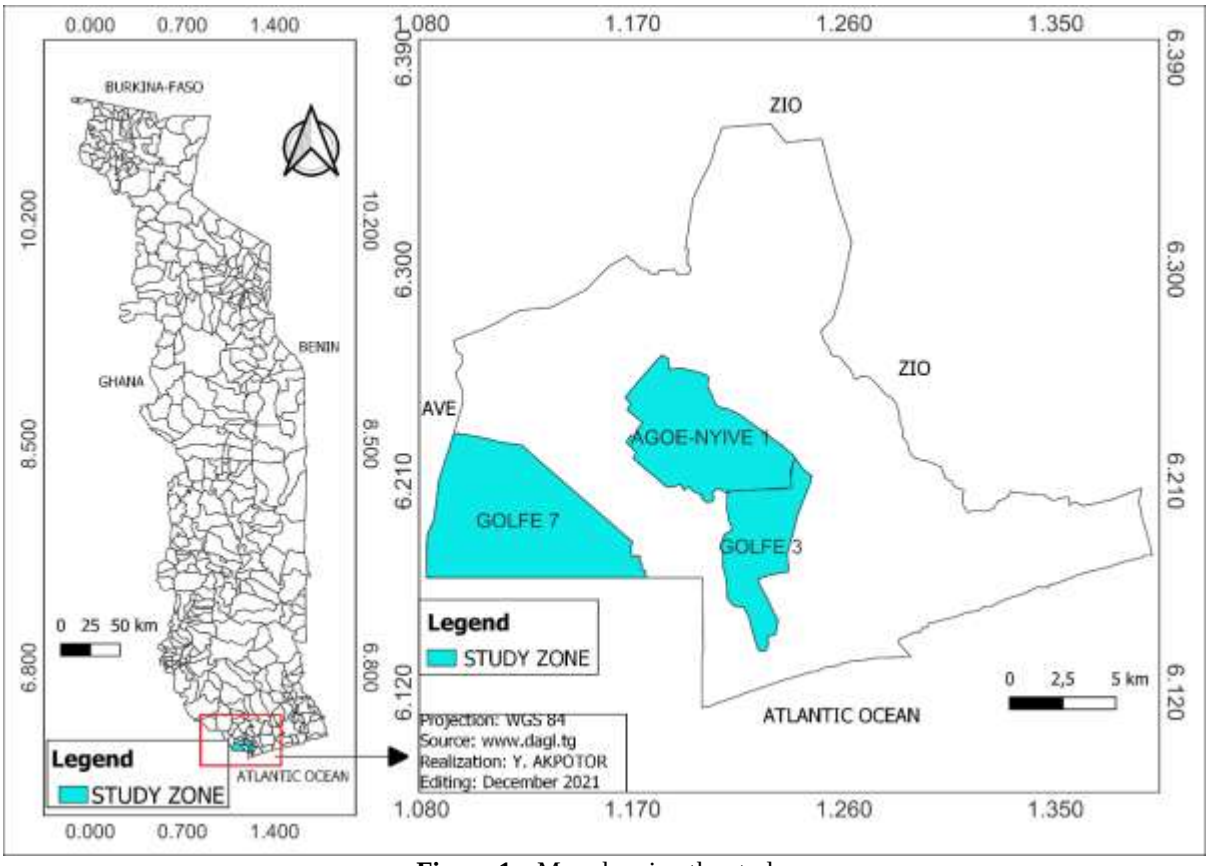

Figure 1:- Map showing the study area

Survey

The survey was carried out through a questionnaire to assess the knowledge about *Macrotermes*alates and their consumption and also about the discomfort susceptible to be cause by that consumption. This survey was conducted in the municipalities of Agoè-Nyivé 1, Golf 3 and Golf 7 from June 14 to July 14, 2021 with three hundred and forty-five (345) participants recruited at random and based on their availability to participate in the study. Volunteers who reside outside the study area were not included. The survey was conducted using pre-tested survey forms. These three municipalities were chosen because of the cosmopolitan nature of their residents.

Statisticalanalysis
Data processing was done using SPSS 20. The significance level was considered at the 5% level ($p< 0.05$).

Results And Discussion:-

The survey focused on socio-demographic data, knowledge level and consumption of *Macrotermes* alates. Among 345 participants interviewed, 300 respondents agreed to provide a response. The non-response rate was therefore 13.04%.

Socio-demographic characteristics of respondents

Distribution of respondents by gender and age

Of the respondents who filled the questionnaire, 50.7% were male and 49.3% were female (**Table 1**). Although the percentage of male was slightly higher than that of female, no significant difference ($p > 0,05$) was found between the two percentages indicating the parity between male and female.

Table 1:- Distribution of respondents by gender.

	Sex	**N**	**%**
	Female	148	49.30
	Male	152	50.70
Total		**300**	**100.00**

Similarly, 92.7% of respondents were between 19 and 59 years old (**Table 2**), reflecting the youthfulness of the population in these three municipalities. This relative youthfulness of the surveyed population was consistent with the trend observed in developing countries where the proportion of young people is greater than that of the elderly.

Table 2:- Distribution of respondents by age.

	Age range	**N**	**%**
	12-18	3	01.06
	19-35	164	54.70
	36-59	114	38.00
	60 years and older	19	06.30
Total		**300**	**100.00**

Distribution of respondents by ethnicity

A total of 13 ethnicities were identified among the surveyed persons, showing the ethnic diversity of the three municipalities and their cosmopolitan status (**Table 3**).

Table 3:- Distribution of respondents by ethnicity.

	Ethnicities		**N**	**%**
	SouthernEthnicities	Adja	6	02.00
		Akébou	3	01.00
		Akposso	6	02.00
		Ewé	97	32.30
		Fon	15	05.00
Subtotal 1			**97**	**42.33**
	NorthernEthnicities	Gangame	15	05.00
		Kabyè	70	23.30
		Kotokoli	8	02.70
		Lamba	17	05.70
		Losso	19	06.30
		Moba	14	04.70
		Bassar	18	06.00
		Défalé	12	04.00
Subtotal 2			**203**	**67.67**
Total			**300**	**100.00**

The ethnic diversity observed in these three municipalities can be explained by the massive rural exodus of the population, which tends to settle in the suburbs of the city of Lomé such as Agoè-Nyivé 1, Golfe 3 and Golfe 7. It also appeared that the Ewe and the Kabyè participated more in the survey with proportions of 32.3% and 23.3% respectively. This reflects the national average as the two ethnic groups are the most numerically important.

Knowledge and consumption of *Macrotermes* alates

Knowledge of Macrotermes alates

Alates were well known by the majority (98%) of participants (**Table 4**).

Table 4:- Knowledge of alates

	Knowledge	**N**	**%**
	No	6	2.00
	Yes	294	98.00
Total		**300**	**100.00**

The proportion of the population with relative knowledge of *Macrotermes* alates was almost similar to that reported by Kuegah-Toyo (2012) which was 95%. In addition, each ethnic group has its own appellation for *Macrotermes* alates (**Table 5**).

Table 5:- Vernacular names for alates in some ethnic groups.

Ethnicities	**Vernacular names**
Adja	Konvi
Akébou	Wkaab
Akposso	Hèza, Izavli
Bassar	Inakacha, Koutakpayi
Défalé	Ablà
Ewé	Agniko, Ayamékanami, Conflé, Damidami, Eko, Konvi
Fon	Toutou
Gangame	Itchou
Kabyè	Adjembélé, Adjemdé, Adjenré, Kagnigbarassi
Kotokoli	Gnonnè
Lamba	Amoura
Losso	Kékéwou
Moba	Wouby

Among the Kabyè people, *Macrotermes* alates are called "Adjembélé", "Adjemdé", "Adjenré" or "Kagnigbarassi". Among the Ewe, they are called "Ayamékanami", "Conflé", "Damidami", "Eko", "Konvi" (**Table 5**). It should be noted then that the majority of respondents knew the alates and their names in local languages. The same finding was reported by Ekpo&Oningbinde (2007). Malaisse (2003) indicated that after caterpillars, termites are the most well-known edible insects. Moreover, these termites are consumed by the population in both rural and urban areas.

Consumption of alates

The survey revealed that 94.3% of the respondents have consumed or continue to consume *Macrotermes* alates (**Table 6**).

Table 6:- Consumption of alates.

	Consumption	**N**	**%**
	No response	4	01.30
	No	13	04.30
	Yes	283	94.30
Total		**300**	**100.00**

The data from the present study were higher than that reported by Kuegah-Toyo (2012) who found only 57% of respondents consuming *Macrotermes* alates. This also can be explained by the cosmopolitan status of the population

in the surveyed localities and the inter-ethnic transfer of food habits. However, the results of this study are similar with those reported by Iroko (1996) who reported that termitophagy was in vogue in Togo.

Reasons and forms of consumption of *Macrotermes* alates

Reasons for consuming Macrotermes alates

The majority of respondents (**Table 7**) consumed or had once consumed *Macrotermes* alates for their taste (48.67%) or for their nutritional value (28.67%).

Table 7:- Reasons for consuming *Macrotermes* alates.

	Reasons	**N**	**%**
	Local custom	33	11.00
	Pleasure	4	01.33
	Therapeuticproperties	13	04.33
	Flavor	146	48.67
	Nutritional value	86	28.67
	No answer	18	06.00
Total		**300**	**100.00**

Organoleptic characteristics are really a source of motivation and have a very great influence on food acceptability (MacEvily, 2000). Indeed, the aroma and taste of a food have a great power of appetite and stimulate consumption (Bauer et al., 2010). Termites, like other insects, have a very thin cuticle that is less crunchy and appetent for consumers (Mignon, 2002). They are also a source of nutrients for the population due to their high protein content. According to Tango (1981), termites are often eaten by populations instead of meat and fish during the period of their swarming. The use of rations with 12% of termite incorporated into meal, causes a significant average weight gain compared to a ration incorporating 20% of minced meat meal Munyuli&Balezi (2002). Because of their high nutritional value, some edible termites are incorporated into cereal flour for the preparation of porridge for malnourished children (FAO, 2004; Ifié&Emeruwa, 2011). Other reasons indicated by surveyed for eating termites include curiosity to discover new taste and the traditional eating habits of different ethnicities.

Different forms of winged termite consumption

During their swarming period, alates are consumed in large quantities in several forms (**Table 8**).

Table 8:- Forms of consumption of alates.

	Formes	**N**	**%**
	No answers	27	09.00
	Raw	1	00.30
	Raw, roastedwith or withoutseasoning	3	01.00
	Raw, roasted and seasoned	15	05.00
	Cooked in a sauce	2	00.70
	Roasted and seasoned	129	43.00
	Roastedwithoutseasoning	113	37.67
	Roastedwith or withoutseasoning	10	03.33
Total		**300**	**100.00**

According to the data, 89% of the respondents consumed *Macrotermes*alates after roasting it. In fact, most consumers of alates prefer to roast them before eating them. Roasting eliminates most germs through the heating, but also reduces water activity in the food and improves its organoleptic characteristics.

Figure 2:- Photo of *Macrotermes*sp alates captured (**A**) and roasted (**B**) traditionally

Discomforts associated with the consumption of alates

The evidence of the benefits of termite consumption is clear. However, the fact remains that the lack of hygiene applied during the preparation and packaging of these alates can lead to health problems for consumers. Several respondents reported some discomforts after have eaten alates (**Table 9**).

Table 9:- Discomfort after eating *Macrotermes* alates.

	Discomfort	**N**	**%**
	No response	17	05.70
	No	152	50.70
	Yes	131	43.70
Total		**300**	**100.00**

According to these results, 43.7% of the respondents revealed that they experienced discomfort after consuming the alates. These discomforts were mainly stomach ache and diarrhea (**Table 10**).

Table 10:- Types of discomfort after eating *Macrotermes* alates.

Types of discomfort		**N**	**%**
	No response	169	56.30
	Diarrhea	82	27.30
	Diarrhea, Stomach ache	34	11.30
	Stomach ache	15	05.00
	Total	**300**	**100.00**

Of the 300 respondents who answered, 82 (27.3%) revealed that they had suffered from diarrhea, 15 (5%) had stomach pains and 34 (11.3%) had suffered from both of the above aches. These gastrointestinal troubles may lead to a decline in the consumption of these alates. Improved treatment of these termites along with good hygienic practices, would limit these adverse effects for consumers., in the interest of promoting the consumption of these edible insects.

Conclusion:-

This study assessed knowledge and dietary practices in relation to *Macrotermes* alate consumption. The majority of participants have a good knowledge of *Macrotermes* alates consumption. There is no particular age of consumption,

as it is practiced by children, adolescents, young people and adults alike, and concerns all social strata and all ethnic groups surveyed. The various consumers essentially emphasize their attachment to the flavor and nutritional value of alates. Alates are eaten fresh or grilled and can cause discomfort such as stomach aches and diarrhea.

The evaluation of the microbiological quality of these alates is therefore necessary to identify the cause of the above-mentioned gastrointestinal discomforts.

Ethicalconsideration
The authors state thatthey have respected all ethicalconsiderationsinthisstudy.

Sources of Support
None.

Declaration of CompetingInterest
The authors report no declarations of interest.

Author Contributions
Conceived and questionnaire administration: KadangaMawabena, KasseneyDodji Boris, DossouBayi Reine and MélilaMamatchi; Analyzed the data: KadangaMawabenaand AwilliTètouwala;Wrote the paper: KadangaMawabena, KasseneyDodji Boris, DossouBayi Reine,MélilaMamatchi and AwiliTètouwalla; Supervised the activities: TchacondoTchadjobo and GlithoAdolé Isabelle.

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