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EFFECTS OF PRESERVATION METHODS ON THE PROXIMATE COMPOSITION OF THE WHITE ANTS (Isoptera: Termatidae)

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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. The aim of this study was to determine effects of preservation methods on the proximate composition of the white ants preserved by different methods. Data were collected and analyzed for proximate composition of moisture, crude protein, ash, crude fibres and gross energy production. Results indicated that under traditional and modern preservation methods, only sun drying resulted to increased water loss, crude proteins and fibres and gross energy production. Roasting was the least appropriate method of preserving white ants as it causes massive denaturation of crude proteins and fibres reducing gross energy release due to reduced respiratory substrates. This study therefore concludes that sun drying should used as preservative measure of the white ants food and recommends that more research should be conducted to establish the optimum sun drying temperatures required to obtain the obtain optimum desiccation and crude proteins and fibres

Keywords: *Effects, preservation, proximate, composition and white ants.*

INTRODUCTION

Termites are social insects that belong to the order Isoptera, which means are winged and have been around on this planet for over 100 million years dating back to Mesozoic or late Paleozoic times (Pearce, 1997). Termites can be separated taxonomically using different features: external morphology, internal features, food and nest type, chemical and behavioral differences (Pearce, 1997). Eggleton, 2001 revised earlier works on classification of termites and classified known termite species into seven families, namely: Mastotermitidae, Kolotermitidae, Termopsidae, Hodotermitidae, Rhinotermitidae, Serritermitidae, and Temitidae. Termitidae being the largest family, 14 subfamilies, 280 genera and over 2600 species (Krishna, 1970; Pearce and Waite, 1994; Kambhampati and Eggleton, 2000; Eggleton, 2001). These seven families may be divided into two main groups, the lower and 'higher termites' depending on their mode of digestion. The first six families are collectively known as lower termites and rely on protozoan symbionts for digestion. Winged individuals (alates) have two pairs of wings, which are similar in size and shape.

Termites live in colonies consisting of a few thousands to several million individuals. Termites are a moderate sized insect order accepted to be an extremely important part of tropical and sub-tropical ecosystems (Eggleton, 1999). 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 (Matsumoto, 1975). The seventh family, Termitidae, represents over 80% of all termite genera and 74% of all termite species (Wood and Johnson, 1986). Termitidae are often referred to as higher termites because of their advanced social behavior (Matsumoto, 1975). Their major characteristics are lack of symbiotic intestinal protozoa, large colonies (100,000 to millions) and the presence of a worker caste that has completed its development ((Eggleton, 1999), i.e. workers do not further develop into reproductive individuals or soldiers.

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, 2006; Were, 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 by-products. 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 heard of cattle. Thus new ways of enhancing protein sources are required to avert the foreseen problem of food insecurity.

To meet these criteria, these diets must however, meet the nutritional requirement and should be readily accepted by the people whom they are intended for (Gatlin, 2007). Therefore, there is a need of finding such food that has the proximate composition to satisfy the demand of the general population.

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, the effect of white ants preservation to nutritional composition of the white ants that would render it suitable as a food source is unknown. It is against this background that this study was carried out to determine effects of preservation methods on the proximate composition of the white ants. Results of the current study will influence preservation and consumption of white ants in Kenya and will reduce chronic food shortages in the country. This research will add to the knowledge of the preservation methods that have been affecting human food.

MATERIALS AND METHODS

This study was carried out in Western Kenya Covering Western Province, Nyanza Province and part of the North Rift (Figure 1). 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 km^2.

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 –25.5ºC 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.

Figure 1. Map of Kenya showing the location of the study area (Source: Adapted and modified from Gatlin., 2007)

Collection of white ant samples

White ants were collected from various parts of Western Kenya during long rain periods when they are expected to be available. Colonies were marked and mapped, and 50% of the colonies were re-sampled during any time there was white ants. Collection of the white ants was done using traps which were mounted on the termite mound to trap the alates. Collections were also made by breaking open the termite mound. Some of the alates and a number of small or large soldiers and workers were preserved (in 70-80% ethanol) for identification at the national museums of Kenya. Approximately 100 live individuals from each colony were Sun-dried after suffocating them in polythene bags. They were also stored in containers with tight lids. Collections did not discriminate between small or large workers, or soldiers.

Proximate analysis

The preserved white ants by sun-drying, salting, roasting and refrigeration were analyzed for proximate composition of crude protein ($N_2 \times 6.25$), crude lipid content, moisture, and ash content using standard methods detailed in AOAC (1995). Dry matter (DM) was determined by oven drying them at 110°C for 24 h. Crude protein (N ×6.25) was determined by Kjehdal method after acid digestion. Crude lipid was determined by the Soxhlet apparatus. Ash content was determined by incineration in a furnace at 550°C for 24 hrs. Crude fibre was determined by digestion with 1.25% H_2SO_4 and 1.25% NaOH solutions. Nitrogen free extracts (NFE) was calculated from the differences. Gross energy was calculated using conversion factors for protein, lipids and carbohydrates provided in Tacon (1998) and confirmed by adiabatic bomb calorimeter. Amino acid compositions of the white ants were determined by automated amino acid analyzer after hydrolyzing the sample for 24 h with 6 M HCl at 110˚C. Sulphur-containing amino acid was oxidized using performic acid before acid hydrolysis. All analyses were performed, in duplicate, on the sub samples of white ants.

RESULTS AND DISCUSSION

RESULTS

Effects of preservation methods on the proximate composition of the white ants.

Sun drying was the most appropriate preservation method. It significantly affected (p <0.05) increased water loss, crude protein, crude fibre and gross energy and decreased ash content in the white termites (Table 1). Roasting was the least appropriate preservation as it significantly (p <0.05) reduced nutrients in the white termites such as crude proteins and crude fibre.However,it also increased ash content and water loss in the delicacy. Other preservation methods such as salting, smoking and freezing fairly positively affected the proximate composition of the white ants.

Table 1. Variation in the proximate composition of the white ants in various preservation media

Proximate composition	Normal	Sundried	Smoked	Salting	Freezing	Roasting
Dry matter	8.8^{d}	4.8^{b}	6.9^{c}	6.5^{c}	11.8^{e}	5.8^{a}
Crude protein	52^{d}	58.6^{b}	55^{c}	50.3^{d}	52.1^{d}	44.5^{a}
Ash	8.4^{b}	6.1^{a}	9.4^{c}	8.3^{b}	8.8^{d}	9.3^{c}
Crude fibre	4.2^{c}	4.8^{a}	4.3^{c}	4.4^{c}	4.5^{d}	3.3^{b}
Gross energy (MJ Kg^{-1})	14.4	18.1	16.2	16.5	15.0	13.2

Mean values in each row with a common superscript letter are not significantly different from each other (P > 0.05).

DISCUSSION

Changes in nutrient composition of the white ants following preservation methods

White ants as a delicacy, is a highly perishable commodity and if not properly handled, quality deteriorates which can have detrimental consequence for the health of the consumers. Various preservation methods have been used worldwide.

Sun drying increased water loss due to solar insolation.It increased crude protein and crude fibres due to its optimal thermal conditions. Increased crude fibres led to highest energy supply due to increased respiratory substrates. The ash content was low due indirect combustion involved.

Smoking, roasting increased desiccation due to increased rate of evaporation caused.However, they decreased both crude proteins and fibre content due to the extremes of temperature the methods provided that denatured them.Denaturation of the crude fibre content reduced the gross energy release due to increased respiratory substrates. These methods increased ash content in the delicacy due to the direct combustion of fuels involved conducting them.

Salting relatively increased water loss in the delicacy due the hyper-osmotic status created by salts leading drawing of water from the white ants. It reduced both crude proteins and fibres due to reactions of the constituent elements in the compounds i.e. salt and the crude proteins and fibres.

Freezing relatively increased both crude protein and fibres as no heating was involved thus denaturation could not occur. Water loss was minimal due to low rate of evaporation caused by the method. Hence the accumulated water in the delicacy reduced the gross energy release due to putrefaction of the crude fibres leading to reduction in the respiratory substrates.

CONCLUSIONS

Sun drying was the most appropriate method of preserving white ants due its enhanced desiccation from the delicacy, increased crude proteins, crude fibres and gross energy in the ants. It also decreased it ash content making it more refined for human consumption addressing the increasing demand items in the country.

RECOMMENDATIONS.

- More research should be conducted to establish the optimum sun drying temperatures required to obtain the obtain optimum desiccation and crude proteins and fibres.
- Shelf – life of the white ant termites preserved by the sun drying should be established to the determine the consumption span from the time of preservation.
- Ways of enhancing commercial sun drying preservation of the white ants should be improved to ensure that the ants are available as a major food source.

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