Technical brief #5:
Nutritional properties of insects for food in Kenya

GREEiNSECT

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DANIDA

Introduction

One of the main arguments for utilizing insects as part of the human diet is their beneficial nutritional profile, comparable to other animal-source foods such as chicken and beef.

This brief presents the some of the research conducted under the GREEiNSECT project on the assessment of the acceptance and nutritional value of food products including house crickets (*Acheta domesticus*) with focus on biscuits and porridge for school feeding programmes. Also, the determination of the optimal point of harvest of farmed crickets is important for the nutritional properties.

Undernutrition and what insects can contribute

Around 30 % of households in Kenya are still food insecure, especially in rural areas. Young children are very vulnerable to poor diets lacking important macro- and micronutrients for their growth and development. In 2014 the prevalence of chronic malnutrition (*stunting*) among children under 5 years of age was 26% while 4% were acute malnourished (*wasted*) (KDCH 2014), with high regional differences. Since children start in pre-school programmes at the age of three years, one way to prevent and treat malnutrition is through school feeding programmes.

Picture 1: Schoolfeeding with cricket biscuits at Nyakasumbi primary school in Bondo, Kenya. *—Source Anja Homann*

Edible insects are a source of both macro- and micronutrients. The protein quality is high, equal to other animal food such as meat (Rumpold & Schlüter, 2013). The protein digestibility can be influenced by processing methods (Kinyuru et al. 2010). The fat quality in terms of saturated and unsaturated fatty acids differs between insect species, and some species can be a source of poly-unsaturated fatty acids (PUFA).

Table 1: Nutritional profile of some edible insects commonly consumed in Kenya. Values are for 100 g of dried insect sample.

Insect species	Green Long horned grasshopper *(Ruspolia differens)*[1]	Brown Long horned grasshopper *(Ruspolia differens)*[1]	*Termite/White ant (Macrotermes subylanus)* (dewinged)[2]	House Cricket *(Acheta domesticus)*[3]	Black ant *(Calebara vidua)*[4]
Macronutrients					
Protein (g)	43	44	39	59	40
Fat (g)	48	46	44	25	47
SFA (%)	38.3	39.1	35.1	52.6	
MUFA (%)	26.6	26.3	52.8	40.5	
PUFA (%)	34.4	33.8	12.2	6.8	
Crude fibre (g)	3.9	4.9		8.0	6.9
Ash (g)	2.8	2.6	7.6	4.0	1.6
Micronutrients					
Calcium (mg)	27.4	24.5	58.7	5.0	22.2
Magnesium (mg)	33.9	33.1		10.0	10.4
Iron (mg)	16.6	13.0	53.3	6.3[5]	10.6
Zinc (mg)	17.5	12.4	8.1	15.0	5.6

1. Kinyuru et al, 2010; 2. Kinyuru et al., 2013; 3. Unpublished data; 4. Ayieko et.al., 2012 5. Rumpold and Schluter, 2013

The exoskeleton of insects contains chitin. The nutritional contribution and potential health impact of chitin is uncertain. Chitin is functionally dietary fiber, which is associated with health benefits in some population groups (e.g. in risk of obesity), while not directly beneficial in undernourished children. Insects may also contain bioactive compounds of potential health benefit beyond the nutritional value, though such activities remain to be documented in human studies (Roos and van Huis, 2017). Also, animal studies have shown that chitin may have prebiotic effects by stimulating growth of *bifido* bacteria and *lactobacilli* (Scholz-Ahrens et al., 2016).

Use of insects in processed foods: The biscuit case

Traditionally, insects like termites, have been consumed whole with minimal processing, directly after collection from the wild. They were eaten raw or roasted, mainly in the Western part of Kenya (Ayieko et al., 2012). Other ethnic groups are less familiar with insects. To introduce insects to people not familiar with eating them, crickets have been ground into powder and used to make snacks, such as pancakes, granola bars, biscuits, cakes, and porridge. Technologies such as extrusion cooking have successfully produced nutritious cricket-based food products.

Picture left: Biscuit baking trials at JOOUST. *—Source Anja Homann*
Middle and right: Biscuits including crickets developed at JOOUST. *—Source Monika Ayieko*

GREEiNSECT school feeding studies

Under the GREEiNSECT project two schoolfeeding studies were carried out, one with biscuits and one with porridge, both including crickets and locally sourced ingredients. Biscuits were chosen due to their familiarity to school children with the product, good processing properties and storage/shelf life qualities. An intervention study at Nyakasumbi primary school in Bondo, showed that biscuits supplemented with 10% cricket powder were well accepted compared to similar biscuits containing whole milk powder. The organoleptic properties, taste and appearance of the cricket biscuits were initially considered less favourable compared to milk biscuits, but improved with daily consumption over four weeks as the children got used to the cricket biscuits (Homann et al. 2017).

In another intervention study conducted in 2017 three types of porridge were tested in a school feeding programme at Cheptigit Primary school in Uasin Gishu County. One porridge was formulated with cricket (Uji poa), one with skimmed milk (Uji fine), and were compared to the plain porridge made of millet and maize only (Uji yetu). There was no difference in acceptability of the three porridges among the school going children. The effects on the nutritional status and gut health were assessed and the data is in the process of being analyzed. The results will be available through the GREEiNSECT website. www.greeinsect.ku.dk

Picture 5: School feeding at Cheptigit Primary school, in Uasin Gishu County, Kenya. *— Source Carolyne Kipkoech*

Optimizing nutritional profile of farmed cricket

A GREEiNSECT study at Jomo Kenyatta University of Agriculture and Technology (JKUAT) assessed the time-point of harvest for optimal nutritional profile of farmed crickets (*Acheta domesticus*) for human consumption. The crickets were fed with vegetables and chicken feed and were kept in containers under controlled conditions, similar to commercially operated cricket farms in Thailand. The nutritional profile was assessed weekly from week 4 to 13 after hatching, in order to follow the development of nutritional properties of the crickets. The final assessment showed that the crickets harvested between week 9-11 offered an optimal nutritional profile, in regard to fatty acid composition, mineral composition, fat to protein ratio and chitin to protein ratio (data in process of publication).

Edible insects in a national nutrition policies perspective

Edible insect species in Kenya have beneficial nutritional properties for human consumption and build on a long tradition for consumption in the Western part of the country. Promoting insects as a nutritious food is important in order to strengthen the image of insects as a nutritional, local food source. GREEiNSECT has shown that crickets successfully can be integrated in foods in school-feeding programmes, which can improve the nutritional quality of the foods and also contribute to make the next generation familiar with insect-based products. In order for products to be successfully marketed, they will need to be developed to meet the preferences of Kenyan consumers for their overall appearance and taste. Farming crickets – and other insect species for which production systems can be made available - can fit in the Kenya Vision 2010 initiative, which seeks to ensure food and nutrition security to all Kenyan by the year 2030. Farming crickets burdens the environment and climate less than other farmed, animals including chicken (Halloran et al., 2017) and can contribute to a sustainable achievement of the Vision 2030 goals. Promoting insect farming and consumption can contribute to attaining the UN Sustainable Development Goal (SDG) #2 on eradication of hunger and ensuring food and nutrition security as well SDG #13 calling for climate action.

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