Indigenous knowledge and potential of termites as poultry feed in Burkina Faso

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Abstract

The purpose of this study, carried out in eight regions in Burkina Faso, West Africa, was to assess the use and knowledge of termites in poultry nutrition in Burkina Faso and to analyse the factors influencing this use. Household surveys were conducted to collect data on the socio-demographic characteristics of poultry farmers and the use of termites in poultry feed. These surveys involved 1,100 farmers in 32 villages. Poultry farmers mostly raise chicken and guinea fowls and these two species are also those that receive termites as supplementary feed. 78% of the surveyed farmers use termites to feed their poultry, but the rate strongly varied among regions and provinces. Several reasons were given for not using termites, the most common being the unavailability of termites followed by the lack of time and not being aware of the technique. Farmers were aware of termite species they consider as toxic in feeding chicks. Understanding the link between the use and availability of termites in poultry nutrition in West Africa is an important step towards the improvement of poultry production.

Keywords: Burkina Faso, insects as feed, poultry, termite use

1. Introduction

Poultry farming in Burkina Faso, as elsewhere in West Africa, plays an important role in the daily life of the rural farmers, who raise village chickens for several purposes (Kondombo *et al.*, 2003; Pousga *et al.*, 2007b). Local poultry is appreciated for its superior taste, justifying the existence of marketing systems to provide the cities with poultry products from the rural areas (Ouedraogo, 2002; Pousga *et al.*, 2007b). Poultry meat and eggs provide protein and energy (Ouedraogo, 2005) and contribute to food security (Kagone, 1999). However, poultry producers suffer from the increasing cost of feed (representing up to 70% of the total production costs) whereas smallholder farmers that maintain scavenging poultry as a side activity also suffer from quantitative and qualitative food shortages (Pousga *et al.*, 2007a,b), affecting production of chicken and eggs, and reducing family income. In Burkina faso, cereals represent the basic food for chickens and guinea fowls (Nougata, 2011; Savadogo, 1995). Animal proteins, e.g. fish meal,

meat meal and blood meal are usually imported and are very expensive for poultry producers and rarely used by smallholder farmers (Pousga and Boly, 2009). Plant protein sources, like cotton and groundnut cake, are not readily available for poultry because they are more commonly used in ruminant feed (Pousga *et al.*, 2007a). The limited amount of quality feed partly explains the low performances observed in traditional poultry farming in Burkina Faso.

Insects represent a sustainable source of proteins that can be used as human food and animal feed (Anankware *et al.*, 2015; Van Huis *et al.*, 2013). Termites are among the most nutritious insects and among the most widely consumed by humans (Lavalette, 2013).

They are also widely used by smallholder farmers to feed poultry in Africa, including Burkina Faso, being given as supplement, in particular during the rainy season (Diawara, 2013; Kenis *et al.*, 2014; Savadogo, 1995). Termites are typically obtained by breaking termite mounds or by

trapping them with inverted pots filled with organic material (Chrysostome *et al.*, 2009; Diawara, 2013; Farina *et al.*, 1991). However, termites are usually given in very small quantities and fowls have to find most of their proteins by scavenging around farms (Hien *et al.*, 2005).

Thus, there is an urgent need to improve traditional poultry feed quality, in particular by facilitating access to insect proteins. The use of termites could be enhanced but, for this a better knowledge of the traditional practices is needed. This paper quantifies the use of termites for poultry feed in Burkina Faso and assesses the relationship among the utilisation and availability of termites in traditional poultry farming in the country.

2. Material and methods

Study area

The study was carried out in eight regions in Burkina Faso, i.e. Centre Ouest, Plateau Central, Nord, Centre Sud, Sahel, Hauts Bassins, Cascades and Est (Figure 1). The regions were selected to cover all three climatic zones of Burkina Faso. These are, from north to south:

1. The Sahelian zone (regions Sahel and part of Nord), situated approximatively north of the 13°30' parallel is defined as a zone experiencing 350-600 mm precipitations that are irregular and unevenly distributed over time and space. Temperatures often reach 40 °C, especially in the hot dry season.
2. The North Sudanian zone, or Sudano-Sahelian zone (Centre Ouest, Plateau Central, Est and part of Nord and Centre Sud) is situated approximatively between the 11°30' and 13°30' parallel, where average annual precipitations vary between 600 and 900 mm.
3. The South Sudanian zone (Hauts Bassins, Cascades and part of Centre Sud) is situated approximatively south of the 11°30' parallel. It receives from 900 to 1,300 mm precipitations annually. This zone experiences milder temperatures.

Figure 1. Regions of Burkina Faso where the study took place.

Maps of the climatic zones and details of the vegetation and agricultural practices in the zones and regions are found in Dembele (2010). Table 1 indicates the agro-climatic zone in which the surveyed villages are situated. Further data on the climate of regions included in this study are found, e.g. in INSD (2014).

Surveys

A total of 1,100 poultry farmers in 32 villages in 25 provinces of the eight regions were interviewed individually from 22 May 2015 to 16 July 2015 (Table 1). In each region, the choice of provinces and villages was based on the number of inhabitants, the accessibility and the proportion of poultry farmers in the localities. The choice of provinces and villages was facilitated by the agents of the Ministry of Animal Resources of Burkina Faso. Inside each province, the villages with the highest number of inhabitants were chosen (INSD, 2008). But to ensure geographic diversity in the samples, they were also selected on different roads. Farmers were randomly selected from lists provided by the Village Development Committees.

In six regions, 30 farmers were selected in each of the five villages per region, whereas 100 farmers were selected from only one village each in Hauts Bassins and Cascades. Direct, face-to-face interviews were conducted by two Master students who understand and speak the local languages of the different villages. The respondents were all farm managers. Surveys were made with a semi-structured questionnaire to collect socio-demographic data of the population, viz: name; age; sex; education level; and profession.

Socio-demographic studies of the studied zones

Table 2 shows the general characteristics of the surveyed population. More men (83.17%) than women were interviewed (Table 2) and most of them were married (96.61%). The majority were crop farmers (78.50%) and had poultry farming as a secondary occupation (91.7%). Many of the respondents had no formal education and used termites (78.04%). More than half (64.5%) of the respondents had not been to primary school. Less than 7% (6.7%) have had high school education.

Statistical analyses

Interviewed poultry farmers were first described and put into two groups: (1) termite users; and (2) non-users. Data from 1,093 respondents were further used in the analysis. The two groups of poultry farmers (termite users and non-users) were separately analysed using descriptive statistics (effective and frequency). All the factors being qualitative (region, province, ethnicity, sex, marital status, instruction level, main occupation, secondary occupation),

Table 1. Distribution of surveyed households per village in the provinces of the regions, and climatic zone of the villages.

Regions	Provinces	Villages and hamlets	No. of households surveyed/village	Climatic zone ¹
Centre Ouest	Sanguier	Kion	30	NS
		Hamlets	30	NS
	Boulkiemde	Poa	30	NS
	Ziro	Kation	30	NS
	Sissili	To	30	NS
Plateau Central	Oubritenga	Ourgou-Manega	30	NS
		Lindi	30	NS
	Ganzourgou	Salogo	30	NS
	Kourweogo	Niou	30	NS
		Hamlets	30	NS
Nord	Yatenga	Oula	30	S
		Boursouma	30	S
	Loroum	Solobo	30	S
	Zondoma	Danaoua	30	NS
	Passore	Rana	30	NS
Centre Sud	Bazega	Tuili	30	NS
	Nahouri	Banon	30	SS
		Tiakané	30	SS
		Yimasga	30	NS
	Zoundweogo	Basgana	30	NS
Sahel	Seno	N'djomga	30	S
		Korea	30	S
	Soum	Pobe-mengao	30	S
	Oudalan	Alliakoum	30	S
	Yagha	Ibbal	30	S
Est	Tapoa	Sambalgou	30	NS
	Gnagna	Boungou-Folgou	30	S
	Komandjari	Oue	30	NS
	Gourma	Diapangou	30	NS
	Kompienga	Bombontangou	30	NS
Cascades	Comoe	Siniena	100	SS
Hauts-Bassins	Houet	Gombedougou	100	SS

¹ S = Sahelian zone; NS = North Sudanian zone; SS = South Sudanian zone; following maps and descriptions in Dembele (2010).

the independence between the proportions of termites users and non-users was tested by chi-square. The effect of different factors on termite use was examined using the binomial regression model. A step-by-step selection of the variables was made before adjusting the model to the data to avoid correlations between the model's explanatory variables. The stepwise regression incorporated both the forward and backward selection approaches and the final model considered only significant explanatory variables. The homogeneity test, the choice of variables and the adjustment of the binomial model to the data were carried out using R3.3.2 (R Development Core Team, <http://www.R-project.org>).

3. Results

Use of termites

About 78% of the farmers said that they give termites to their poultry at least occasionally. The majority of the termite users were male (84.64%), married (97.07%), had no formal education (65.89%) and had crop farming (79.72%) as their main occupation (Table 3). In three regions, Centre Ouest, Hauts Bassins and Nord, farmers used termites more extensively than in other regions. In contrast, in some provinces of the Sahel and Est regions, hardly any farmers use them.

Table 2. Descriptive statistics of the surveyed sample.

Qualitative factors	Factors levels	Size	Percentage
Termites user groups	G1 (termite users)	853	78.04
	G2 (non-termite user)	240	21.96
Region	Cascades	100	9.15
	Centre-Ouest	150	13.72
	Centre-Sud	147	13.45
	Est	149	13.63
	Hauts-Bassins	99	9.06
	Nord	150	13.72
	Plateau Central	150	13.72
	Sahel	148	13.54
	female	184	16.83
	male	909	83.17
Marital status	single	16	1.46
	divorced	11	1.01
	married	1,056	96.61
	widowed	10	0.91
Educational level	other	142	12.99
	none	705	64.50
	primary	172	15.74
	secondary	74	6.77
Principal occupation	agent	11	1.01
	crop farmer	858	78.50
	artisan	8	0.73
	other	10	0.91
	trader	12	1.10
	poultry farmer	88	8.05
	household	106	9.70
Secondary occupation	crop farmer	85	7.78
	artisan	1	0.09
	other	1	0.09
	trader	2	0.18
	poultry farmer	1,003	91.77
	household	1	0.09

The proportions of termite users varied significantly ($P<0.05$) for each level of the different factors studied (Table 3). The stepwise regression selected three factors from the eight: province, sex and main occupation. The result of the binomial regression showed that two of the three factors are determinants of the use of termites: province and main occupation ($P<0.0001$). The detailed result of the binomial regression (Table 4) showed that the provinces of Comoe, Kourweogo, Nahouri, Sanguier, Sissili and Tuy and the main occupations: crop farmer, poultry farmer and housewife positively affected the use of termites by the surveyed poultry farmers. On the other hand, the poultry farmers in the province of Gnagna had a high probability of not using termites.

Table 3. Statistics of the termite and non-termite users.

Qualitative factors	Factor levels	G1 (%)	G2 (%)
Region	Cascades	10.20	5.42
	Centre-Ouest	16.06	5.42
	Centre-Sud	14.30	10.42
	Est	9.96	26.67
	Hauts-Bassins	10.67	3.33
	Nord	16.30	4.58
	Plateau Central	14.30	11.67
	Sahel	8.21	32.50
	<i>P</i>		<0.0001
Sex	female	15.36	22.08
	male	84.64	77.92
	<i>P</i>		<0.05
Marital status	single	1.29	2.08
	divorced	1.06	0.83
	married	97.07	95.00
	widowed	0.59	2.08
	<i>P</i>		<0.0001
Educational level	other	10.43	22.08
	none	65.89	59.58
	primary	17.12	10.83
	secondary	6.57	7.50
	<i>P</i>		<0.0001
Principal occupation	agent	0.47	2.92
	crop farmer	79.72	74.17
	artisan	0.70	0.83
	other	0.82	1.25
	trader	0.82	2.08
	poultry farmer	6.92	12.08
	household	10.55	6.67
	<i>P</i>		<0.0001

Sixteen reasons were given for not using termites (Table 5). In Sahel and Est regions, where termites are less used, the most commonly given reason was the unavailability of termites. Lack of time and lack of awareness of the capturing technique were other common reasons given by respondents.

In all regions, the poultry species most commonly given termites as supplements were chickens, followed by guinea fowls (Figure 2). Turkey, duck and pigeon were also occasionally cited. Figure 3 shows the percentage of owners of poultry species that feed them with termites. The majority of chickens, guinea fowls and turkey owners feed them with termites whereas ducks and pigeons are rarely fed with termites.

Table 4. Result of the binomial linear regression per province.

Factor	Coefficient	Error-type	Probability
(Intercept)	-2.845	1.028	<0.01
Boulkiemde	1.105	0.662	>0.05
Comoe	1.412	0.502	<0.01
Ganzourgou	1.061	0.664	>0.05
Gnagna	-3.429	0.828	<0.001
Gourma	-0.460	0.534	>0.05
Komandjari	-0.015	0.548	>0.05
Kompienga	0.861	0.612	>0.05
Kourweogo	1.370	0.562	<0.05
Loroum	18.291	1,141.063	>0.05
Nahouri	3.274	1.080	<0.01
Oubritenga	0.501	0.502	>0.05
Oudalan	-19.092	1,184.269	>0.05
Passoré	18.30	1,142.14	>0.05
Sanguie	2.392	0.706	<0.01
Seno	-0.061	0.497	>0.05
Sissili	2.777	1.100	<0.05
Soum	-0.189	0.555	>0.05
Tapoa	0.372	0.581	>0.05
Tuy	1.928	0.552	<0.001
Yagha	-0.149	0.578	>0.05
Yatenga	1.011	0.561	>0.05
Ziro	1.300	0.678	>0.05
Zondoma	17.949	1,175.053	>0.05
Zoundweogo	0.403	0.493	>0.05
Male	0.478	0.327	>0.05
PPCrop farmers	3.157	0.911	<0.01
PPArtisan	1.648	1.223	>0.05
PPOther	1.366	1.185	>0.05
PPTrader	1.659	1.110	>0.05
PPPoultry farmer	2.709	0.956	<0.01
PPHousewife	3.467	0.993	<0.001

4. Discussion

Traditional poultry farming is practiced by most farmers in Burkina Faso (Traore, 2006). This survey among 1,100 households in eight regions represents the first survey at that scale on the use of termites to feed poultry in West Africa. About 78% of the farmers said that they give termites to their poultry, mostly chickens and guinea fowls. Termite users were mostly male, married, had no formal education and had crop farming as their main occupation. The higher number of men than women among the respondents is due to the fact that, in Burkina Faso, household interviews are typically answered by men who are the heads of farms and, in many regions, are responsible for poultry farming.

The very high number of farmers using termites as poultry feed in at least six of the eight surveyed regions shows that

farmers are well aware of the need to use protein in poultry nutrition. According to farmers, the collection of termites and its use in poultry feed is an ancestral know-how. For example, most farmers were able to recognise species that are considered as 'toxic' and explained that the toxicity would be due mainly to the large mandibles that would injure or kill chicks when eaten. The most commonly eaten termite species were the large *Macrotermes* species. They are the winged termites that emerge after the rains from holes near termite nests (Anankware *et al.*, 2015). Van Huis (2003) observed that, in Africa, locals beat the ground around termite hills (simulating heavy rain) to provoke the termites to emerge. *Macrotermes* species are suitable both for animals and for humans. Ntukuyoh *et al.* (2012) showed that *Macrotermes bellicosus* have high nutritional qualities. Queen, soldiers and workers were analysed for proximate composition, vitamin, mineral elements and anti-nutrient content. They concluded that *M. bellicosus* is a good source of protein and other micro- and macro-nutrients and they are harmless to eat. More generally, termites are the second most eaten insects all over the world (Chung, 2010).

Chickens and guinea fowls are the two species whose feed were mostly supplemented with termites, in all regions where the investigation was carried out. These results corroborate those of Boko *et al.* (2012) who had also shown that, in sub-Saharan Africa, termites are mainly given to chickens and guinea fowls. These two species are also the most commonly found on farm because they are easy to rear, have higher commercial demand and often used in socio-cultural rituals.

Termites occur in the whole Burkina Faso, although, according to farmers, in some areas their availability is limited. In addition, during the rainy season, some species are more difficult to capture than others. Many reasons were given for not using termites. Among them, the lack of knowledge on capturing techniques, unavailability of termites and the lack of time were the most cited. Considering that the lack of knowledge in the collection and trapping techniques has been cited among the main reasons, there is no doubt that these techniques could be optimised and disseminated, which would improve traditional poultry nutrition. However, the fact that no mass production system is available for termites (Kenis *et al.*, 2014) will limit their use among industrial poultry producers. For these, other insects that can be produced at an industrial scale, would be more suitable. Fly larvae such as the black soldier fly (*Hermetia illucens* L., 1758) or the housefly (*Musca domestica* L., 1758) are particularly appropriate but others such as mealworm (*Tenebrio molitor* L., 1758), and even cockroaches, grasshoppers and crickets could be considered since most insects at all life stages are rich sources of animal protein (Józefiak and Engberg, 2015). They have a great potential as feed, taking into account their nutritional value, low space requirement and the fact that they are relished by poultry and fish, since insects belong to their diet in their natural habitat (Rumpold and Schlüter, 2013).

Table 5. Reasons for not using termites per region.¹

	Cascades	Centre Ouest	Hauts bassins	Nord	Plateau Central	Centre Sud	Est	Sahel
Choice	-	+	-	+	-	-	-	-
Lack of interest	+	-	-	-	-	-	-	-
Difficult	+	-	-	-	-	+	+	+
Distance	-	+	-	-	+	-	-	-
Unavailability	-	-	-	-	+	+	+++	+++
Lack of knowledge on termites	+	+	+	+	+	-	+	+
Poultry mortality	+	+	+	-	+	+	+	-
No need	+	-	-	-	-	-	+	+
Not interested	-	-	-	+	-	+	+	+
Lack of time	+	+	+	+	++	+	-	+
Seasonality of termites	-	-	-	-	+	-	-	-
Scarcity of termites	-	-	-	+	-	-	-	-
Lack of knowledge on capturing techniques	-	+	-	+	-	+	+	++
Toxicity of termites	-	+	-	+	+	-	-	-
Too old	+	-	-	-	+	+	-	-
Carefulness	-	-	-	-	+	-	-	-

¹ Signs indicate the number of answers: - = absence; + = 1 to 10; ++ = 11 to 20; +++ = >21.

Figure 2. Percentages of farmers claiming that they feed chicken, guinea fowl or turkey with termites in the eight regions. Too few farmers cited duck and pigeons to be shown in the graph. Lines above the bars illustrate standard error.

5. Conclusions

Poultry farming is practiced by the vast majority of farmers in Burkina Faso. Termites play an important role in traditional poultry farming since it is often the only source of protein given to domestic fowls and guinea fowls. Farmers of all age categories and sexes collect

Figure 3. Percentage of the owners of five poultry species that supplement their feed with termites. Lines above the bars illustrate standard error.

termites to supplement poultry feed. However, depending on the region, some constraints may limit their use, in particular seasonal availability, lack of knowledge and lack of time. These result in important variations observed among regions and provinces in the frequency of termite use by farmers. Nevertheless, the fact that termites are already used by a majority of farmers in the country opens perspectives for the improvement of collection and production techniques, which would surely have a positive influence on poultry health and production and, indirectly, on smallholder farmers' livelihood. Experiments are on-

going in Burkina Faso to compare the different collection methods and improve the trapping system, for example by finding the best attractants or the best trapping designs, and disseminate the most efficient and sustainable methods. In addition to termites, other insects could be used to feed local poultry in smallholder farms. An appropriate species selection based on easiness and suitability for production and characteristics such as safety, protein/biomass supply on intended use is necessary (Kenis *et al.*, 2014; 2018; Rumpold and Schlüter, 2013). Low-cost production systems that are easily manageable by farmers need to be developed. Fly larvae are particularly adapted to such systems because they can be easily produced on organic wastes at low scales and, in addition, provide by products such as biofertilisers (Koné *et al.*, 2017; Nyakeri *et al.*, 2017; Pomalégny *et al.*, 2017).

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