ISSN 1682-8356
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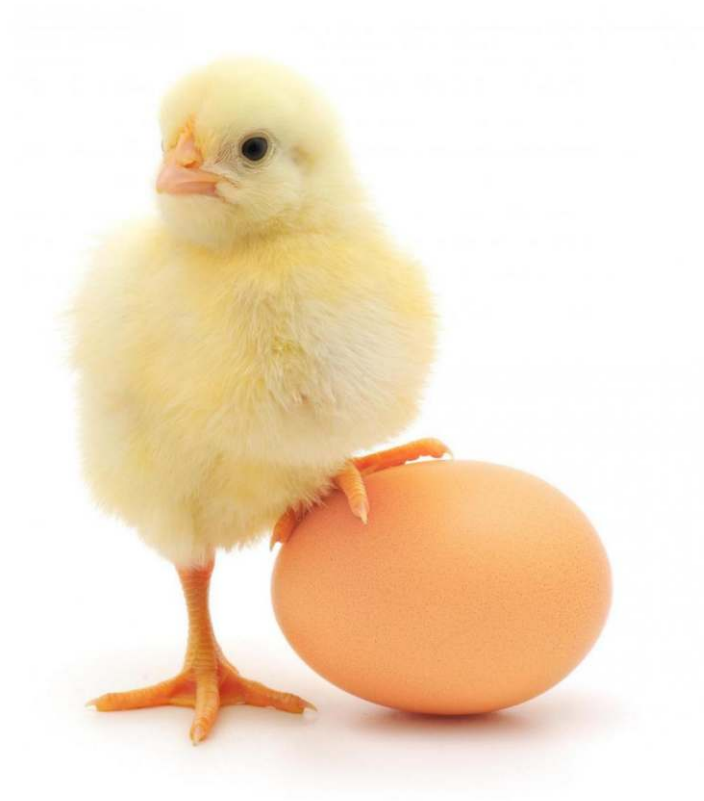

INTERNATIONAL JOURNAL OF POULTRY SCIENCE

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International Journal of Poultry Science 10 (9): 734-749, 2011
ISSN 1682-8356
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Growth Performances, Carcass and Organs Characteristics and Economics Results of Growing Indigenous Senegal Chickens Fed Diets Containing Various Levels of *Leuceana leucocephala* (Lam.) Leaves Meal

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Abstract: The aim of this study carried out from September to December 2010 was to evaluate the effects of *Leuceana leucocephala* leaves meal inclusion in the diets on growth performances, carcass and organs characteristics and economics results of growing indigenous Senegal chickens. One hundred and four (104) indigenous Senegal chicks of 4 weeks old were randomly allocated into four groups of 26 chicks each with similar body weight. Each group subdivided in two repetitions of 13 birds, corresponded to each of the four (4) dietary treatments LL_0, LL_7, LL_{14} and LL_{21} containing respectively 0, 7, 14 and 21% of *Leuceana* leaves meal in substitution of groundnut cake meal. During the experiment (5-17th week old), zootechnical parameters of birds and economical data were recorded and analyzed per dietary treatment. At the end of the 13 weeks trial, the final Live Body Weights (LBW) were 864 g, 1166.48 g, 905 g and 887.16 g/bird, the Average Daily Weight Gain (ADWG) were 7.77 g, 10.88 g, 8.15 g and 8.10 g/day, the Daily Feed Intake (DFI) of 39.86 g, 51 g, 40.39 g and 44.75 g/bird and the Feed Conversion Ratio (FCR) of 7.04, 5.54, 6.27 and 6.80 respectively for birds fed LL_0, LL_7, LL_{14} and LL_{21} diets. The *Leuceana* leaves meal inclusion in the diets up to 21% had not caused any adverse effect on LBW, ADWG, DFI, FCR, mortality, carcass and organs characteristics in birds compared to their controls. Apart from the dark yellowing of abdominal fat of carcasses from birds fed LL_{21} diet, significantly better growth performances, feed costs and economic margins were recorded in birds fed LL_7 and LL_{14} diets. Thus, these two dietary treatments were the only most economically profitable (respectively 214 and 48 FCFA/kg carcass of additional profit) compared to the control.

Key words: Growth performances, feeding, economic margin, indigenous chickens, *Leuceana leucocephala* leaves, carcass and organ characteristics, Senegal

INTRODUCTION

In Senegal or in sub-Saharan Africa, the indigenous poultry farming, although very little concerned by development projects (states paying more attention to the industrial poultry), accounts for 75-80% of poultry herd and is practiced by almost all peasants, including women and children of rural areas (Agbede *et al.*, 1995; Gueye, 2000; Bebay, 2006; Traore, 2006). It remains the most widespread or common way of livestock handling and constitutes an important pillar of food security improvement, socio-cultural and economic development despite the remarkable growth recorded in recent years in industrial poultry (Kitalyi and Mayer, 1998; Missohou *et al.*, 2002; Alders, 2005; Dieye *et al.*, 2010). In most developing countries, indigenous chickens or its products in the market are more expensive than that of selected exotic chickens. Traditional poultry farming contributes to 70% of poultry production and provides

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about 20% of the consumed protein by the population in these countries (Alders, 2005; Fotsa *et al*., 2007; Teno, 2009). Despite these many important roles, the traditional poultry development is still limited by various constraints among which food is a major challenge. Apart from diseases and predators, village poultry faced a recurring quantitative and qualitative food shortage particularly in poor agricultural or household residues environment in addition to the inadequate or lack of dietary supplement (Buldgen *et al*., 1992; Bonfoh *et al*., 1997; Gueye, 1997; Hofman, 2000; Tadelle and Ogle, 2001; Sonaiya and Swan, 2004; Rashid *et al*., 2005; Pousga *et al*., 2005; Halima *et al*., 2007a). Moreover, the commons protein sources (groundnut cake, soybean, etc.) and other ingredients used in poultry feeding have become too expensive because of their excessive demand in Senegal or in international market due to the context of their diversion to biofuel production (Doumbia, 2002). All this, consequently, had highly reduced access to these resources for poor traditional stockholders compared to industrial poultry farmers, with the resulting a low productivity of village poultry flock. Several authors had shown that fed in partial or total improved dietary supplement, particularly with diet based on local and cheaper ingredients is necessary to maximize productivity and profitability in village chickens breeding (Buldgen *et al*., 1992; Kondombo *et al*., 2003; Rashid *et al*., 2004; Riise *et al*., 2004; Pousga *et al*., 2006; Halima *et al*., 2007b; Kingori *et al*., 2007). In these conditions and in order to allow indigenous poultry livestock to contribute effectively to the poverty and food insecurity alleviation, it would be useful and essential to increase their productivity by improving their feeding strategies through available unconventional and local feed resources' utilization, from which the interest of this study. At this end, studies carried out on leguminous or by-products such as *Leuceana leucocephala* leaves available in Senegal, have reported that they were important feed resources relatively rich in nutrients, carotenoids pigments and vitamins (Akbar and Gupta, 1985; Ekpenyong, 1986; Aletor and Omodara, 1994; Ayssiwede *et al*., 2011; Mutayoba *et al*., 2011). Although the presence of mimosine, an important toxic factor has often been mentioned as the handicap of their intensive use (D'Mello, 1992 and 1982; Semenye, 1990), they have been used both in ruminants (Jones and Megarrity, 1983; Pamo *et al*., 2005) and in poultry or monogastrics feeding with various performances depending on their nutritional value and inclusion level in the diets (Ter Meulen *et al*., 1984; D'Mello *et al*., 1987; D'Mello and Acamovic, 1989; Hussain *et al*., 1991; Atawodi *et al*., 2008; Onibi *et al*., 2008). Ayssiwede *et al*. (2010b) had previously found that *L. leucocephala* leaves meal incorporation in the diets of adult indigenous chickens up to 21% in partial substitution of groundnut cake meal, had not caused any adverse effect on nutrients retention and significantly improved apparent coefficients of nutrients and energy utilization, particularly in birds fed diets containing 7 and 14% of these leaves meal. The aim of this study was then to assess the effects of *Leuceana* leaves meal inclusion in the diets on growth performances, carcass and organs characteristics and economics results in growing indigenous Senegal chickens.

MATERIALS AND METHODS

Vegetable material and other ingredients used in experimental diets: The *Leuceana leucocephala* leaves used for this study were mainly collected in the region of Thies, 70 km from Dakar, particularly in the High National Agricultural School of Thiès (ENSAT) and in the neighbourhood villages' fields. Branches of plants bearing leaves were cut and transported to the ENSAT where they were displayed evenly under a semi-open shed for 1-2 days. The branches and twigs were then removed and the leaflets of the leaves were retrieved. They were sun-dried during 1-3 days until they become soft crispy while still retaining the greenish coloration. Indeed, drying was able to reduce or eliminate the potential labile toxic factors (mimosine, lectin) present in the leaves (D'Mello and Fraser, 1981; Tangendjaja *et al*., 1984; Wee and Wang, 1987). These sun-dried leaves were then processed into meal using a grinder mesh of 4 mm in diameter. The leaves meal was packaged in bag of 50 kg and stored until use. The other ingredients used reported in Table 1, were bought at the markets of Dakar and Thiès. Samples of the various ingredients including *Leuceana* leaves meal were subjected to proximate analyses before being used in the experimental diets formulation.

Proximate analyses and experimental diets formulation: Chemical analyses were carried out in the laboratory of food and animal nutrition of Dakar's Inter-states School of Sciences and Veterinary Medicine (EISMV). They were focused both on the various ingredients and the experimental diets and concerned the determination of Dry Matter (DM), total ash, Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF) and minerals, particularly calcium and phosphorus. The DM and total ash of different samples were obtained according to standard methods of the French Association for Standardization, AFNOR (1977). The CP content was based on the Kjeldahl method (N*6.25) and that of EE was determined by reflux extraction method for 6 h with diethyl ether using the Soxhlet apparatus described by the same standard. The CF determination was carried out following AFNOR (1993) standard based on the Weende's method. The calcium was measured according to the photometric absorption method of AFNOR (1984) and the total phosphorus determination was done using the spectrophotometric method at

Table 1: Ingredients composition and calculated nutrients value of *Leuceana Leucocephala* (LL) experimental diets for growing indigenous senegal chickens

		Dietary treatments			
Ingredients	Ingredients prices (FCFA[1]/kg)	LL_0	LL_7	LL_{14}	LL_{21}
Yellow maize (%)	160.00	24.00	26.40	29.14	28.50
White sorghum (%)	150.00	14.00	13.62	8.00	5.00
Millet (%)	185.00	18.00	14.00	16.00	17.80
Groundnut oil (%)	1110.00	0.00	0.80	1.30	2.00
Wheat bran (%)	100.00	16.50	14.00	9.10	5.00
Groundnut cake (%)	150.00	23.00	18.00	16.00	14.00
Leuceana leaves meal (%)	65.00	0.00	7.00	14.00	21.00
Fish meal (%)	415.00	0.25	2.20	2.70	3.00
Dicalcium phosphate (%)	184.00	1.15	0.85	0.90	0.70
Food chalk (%)	90.00	0.50	0.40	0.00	0.00
Lysine (%)	2480.00	0.30	0.22	0.14	0.07
Méthionine (%)	4500.00	0.00	0.00	0.00	0.00
Macrovitamix, CMV (%)	860.00	2.00	2.00	2.00	2.00
Ferrous Sulfate (%)	600.00	0.00	0.21	0.42	0.63
Liptol[2] (%)	1640.00	0.15	0.15	0.15	0.15
Fintox[3] (%)	1045.00	0.15	0.15	0.15	0.15
Total	-	100.00	100.00	100.00	100.00
Calculated nutrients values					
Dry Matter, DM (%)		90.53	90.76	90.88	91.08
Crude Protein, CP (%DM)		20.80	20.49	20.52	20.48
Ether Extract, EE (%DM)		6.87	7.22	7.70	8.33
Crude Fiber, CF (%DM)		4.87	5.23	5.45	5.74
Total Ash (%DM)		6.10	6.61	6.78	7.09
Calcium, Ca (%DM)		1.04	1.07	1.06	1.13
Phosphorus, P (%DM)		0.67	0.69	0.68	0.63
Lysine (%DM)		0.92	0.94	0.93	0.93
Méthionine (%DM)		0.41	0.42	0.43	0.44
Metabolizable energy, ME (kcal/kg DM)		3105.47	3110.00	3165.60	3210.00
[ME/CP] ratio (kcal ME/g CP)		14.93	15.18	15.43	15.67

FCFA[1]: Money of the French Community of Africa, 1€ = 655.957 FCFA; LL_0: Control diet containing 0% of *Leuceana leucocephala* leaves meal; LL_7: diet containing 7% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL_{14}: diet containing 14% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL_{21}: diet containing 21% of *L. leucocephala* leaves meal in substitution of groundnut cake; CMV (mineral and vitamin complex, macrovitamix[ND]): contain per kg 1400 mg of Manganese, 1200 mg of Zinc, 1400 mg of ferrous, 20 mg Copper, 8 mg ode, 2 mg cobalt, 2.8 mg selenium, 250000 UI vitamin A, 50000 UI vitamin D, 50 mg, 100 mg, 480 mg, 195 mg, 55 mg, 0.6 mg, 290 mg, 50 mg, 175 mg of vitamins B_1, B_2, B_3, B_5, B_6, B_{12}, E, K_3 and C respectively, 27 mg of folic acid, 0.6 mg of biotin and 0.6% of cholin.

Liptol[2]: antifungal and antibacterial preservative.

Fintox[3]: preservative absorbing mycotoxins

430 nm as described by AFNOR (1980). The Metabolizable Energy (ME) of experimental diets analyzed, was calculated according to the regression equations of Sibbald *et al.* (1980) cited by Leclercq *et al.* (1984). From the different ingredients analyses results (Ayssiwede *et al.*, 2010b), four approximately isonitrogenus and isocaloric experimental growing chickens diets (LL_0, LL_7, LL_{14} and LL_{21}) were formulated to contain respectively 0, 7, 14 and 21% of *L. leucocephala* leaves meal in a partial substitution to groundnut cake, major protein source of the diets. So as to detoxify the mimosine, main anti-nutritional factors, the *Leuceana* leaves based diets (LL_7, LL_{14}, LL_{21}) were supplemented according to D'Mello and Acamovic (1982) or Springhall and Ross (1965) with ferrous sulphate at 30 g/kg of leaves meal. The ingredients composition and calculated nutritive value of these four *Leuceana* experimental diets are presented in Table 1.

Indigenous Senegal chicks production and management: The experimental birds were products of indigenous Senegal cockerels and hens and/or crosses between Blue Holland cockerels and local breed hens which were bought from four principal regions (Dakar, Thies, Louga and Kolda) of Senegal. The resulting eggs obtained from their breeding were collected for artificial incubation using an electronic incubator of 252 eggs capacity. After hatching, the one hundred and four (104) indigenous chicks obtained were confined and fed a commercial ordinary starter diet until four (4) weeks of age. The chicks were vaccinated against the Newcastle and Gumboro diseases. Amprolium 20%® or Anticox® was dissolved in the drinking water for 3 days to prevent avian coccidiosis, Piperazine-citrate® or Polystrongle® was given for 1-2 days against digestive tract parasites while Neoxyvital® or Coliteravet® was used for stress prevention. Globally, it have been applied to the birds the

Table 2: Vaccination and disease prophylactic control program applied to growing indigenous senegal chickens

Age of chicks (days)	Diseases	Veterinary products administrated
1	Newcastle disease	Imopest HB1 (oral tract)
1-4	Stress prevention	Néoxyvital (oral tract)
9	Bursitis Infectious (Gumboro)	Hipra-Gumboro-CH80 (oral tract)
9-11	Stress prevention	Néoxyvital (oral tract)
17-20	Avian coccidiosis	Amprolium 20% (oral tract)
21	Newcastle disease	Imopest HB1 (oral tract)
21	Bursitis infectious (Gumboro)	Hipra-Gumboro-CH80 (oral tract)
21-23	Stress prevention	Néoxyvital; Coliteravet (oral tract)
28-29	Digestive tract parasite	Pipérazine citrate+Amin Total (oral)
42-45; 63-65; 91-93	Avian coccidiosis	Anticox, Amprolium 20% (oral tract)
56-57; 84-85	Digestive tract parasite	Polystrongle +Amin Total (oral tract)

prophylactic measures against some common chicken diseases in Senegal according to the vaccination and disease control programme shown in Table 2.

Back ground, experimental design and data collection: The experiment was undertaken at EISMV-Dakar located in Dakar's department area. Dakar is an ecological peninsula zone of Senegal partially bordered by Atlantic ocean located in 14°40'N and 17°26'W, characterized by a special microclimate with an average moderate temperatures ranging from 19-24°C and an annual rainfall about of 500-600 mm. The trial was carried out from September to December 2010 and involved the 104 previous indigenous Senegal chicks of 4 weeks old. At the end of the 4th week of age, the chicks were individually identified in their wing using a special bird ring and divided according to a completely randomized design into four dietary treatment groups, with 2 replicates of 13 birds for each treatment. The four treatment groups of birds, having substantially identical live body weight, were corresponded each to the four previous *Leuceana* experimental diets: LL_0, LL_7, LL_{14} and LL_{21}. Data collection started after the four weeks of age, i.e. from 5th to the 17th week of age. For 13 weeks trial, the birds of each treatment groups were fed respectively with the corresponding *Leuceana* experimental diets. During the first five days of the experiment, the birds receiving the *Leuceana* leaves meal based diets (LL_7, LL_{14} and LL_{21}) were adapted to their feed by a gradual diet transition which consisted in linearly replacing of feed usually distributed by *Leuceana* leaves based diets in the total daily feed offered. The birds were reared on ground litter constituting of wood chips in a semi-open house, with tile cement roof and single slope, where breeding standards (cooling, ventilation, water-troughs, feeders, etc...) were largely respected. They were lit by natural light during the day and by two artificial linear lights of 60 watts capacity at night. The density applied for the treatment groups was 8 birds/m^2. The feed were distributed to growing chickens twice a day (at 8 h AM and 5 h PM) in linear galvanized feeders while plastic siphon water-troughs of 5 liters capacity were used to provide them water *ad libitum*. During the experiment, the environmental factors in the trial local, certainly temperature and humidity were regularly measured and recorded using a thermo-hygrometer, as well as zootechnical parameters such as live body weight, feed consumption and chickens mortality. Monitoring of deaths and feed consumption (quantity of feed offered - feed refused) were done on a daily basis while the individual live body weights of birds were undertaken at weekly using an electronic scale SF-400.

Carcass and organs characteristics evaluation: At the end of the trial (17 weeks old), 24 indigenous chickens (either 6 birds/treatment group) were randomly selected, weighed and killed by severing the jugular vein to assess the impact of *Leuceana* leaves meal inclusion in the diets on carcasses and organs characteristics. Chickens slaughtered per dietary treatment were dipped in hot water, defeathered, eviscerated and their carcasses were individually weighed. Then the various organs identified in bird carcasses, especially liver, heart, lungs and spleen were also dissected, weighed separately and recorded per treatment. The yellow coloration of the skin and abdominal fat of carcasses was measured using a similarly technical scoring applied by Kaijage *et al.* (2003) or Onibi *et al.* (2008) in which the score varied from 1 to 4 according to the intensity of the yellowing observed (1: no yellow color, 2: light to moderate yellow color, 3: enough to well yellow color and 4: intense to dark yellow color).

Zootechnical parameters and economics results determination: Data collected on live body weight, feed consumption, mortality, carcass weight, organs weight, yellow scores of the skin and abdominal fat, etc., were entered into the Microsoft Excel table and zootechnical parameters of birds were calculated. The economic appraisal of the experimental diets was made basis, firstly on the local market prices of various ingredients and by-products used (Table 1) during the period of the study to determine the feed price per kg diet and, secondly, on feed cost per kg live body weight or per kg carcass and selling price per kg carcass of chickens. The *Leuceana* leaves meal incorporated in the diets were not bought. But in assessing the feed price/kg experimental diets (LL_0, LL_7, LL_{14} and LL_{21}) produced, a flat price of 65 FCFA/kg of sun-dried leaves was determined to take into account the opportunity cost induced by the time spent for their harvesting and processing. The Daily Feed Intake (DFI), Average Daily Weight Gain (ADWG), Feed Conversion Ratio (FCR), Dressing Carcass (DC), Mortality Rate (MR), as well as feed costs, selling price, Gross Margins Food (GMF) and Supplementary Net Margins (SNM) or profits generated per bird or per kg carcass were similarly determined and recorded per dietary treatment according to the formulas below:

DFI (g/bird/day) = [(Quantity of feed offered - Quantity of feed refused)/day ÷ Number of birds]

ADWG (g/day) = Weight Gain of the period (g) ÷ Length of the period (days)

FCR = Feed intake during a period (g) ÷ Weight Gain of the period (g)

DC (%) = (Carcass weight of the bird ÷ Live body weight of the bird)*100

MR (%) = [(Initial number of birds - Final number of birds) ÷ Initial number of birds]*100

Feed Cost/bird (FCFA) = FCR * Feed price/kg diet * Live body weight of bird (kg)

Feed Cost/kg carcass (FCFA) = [(Feed Cost/bird) ÷ Carcass weight of bird (kg)]

Selling price/bird carcass (FCFA) = Carcass weight of bird (kg) * Selling price/kg carcass

Gross margins food (GMF)/bird carcass (FCFA) = (Selling price/bird carcass) - (Feed Cost/bird)

Gross margins food (GMF)/kg carcass (FCFA) = (Selling price/kg carcass) - (Feed Cost/kg carcass)

SNM/kg carcass (FCFA) = (GMF/kg carcass/group) - (GMF/kg carcass of control group)

Treatment and statistical analyses: Data collected on birds performances and economics evaluation per dietary treatment were recorded and treated with Microsoft Excel table. They were then subjected to one factor Analysis of Variance (ANOVA) at 5% level ($p<0.05$) using the Statistical Package for Social Science (SPSS) software. When ANOVA analysis test showed significant dietary treatments effects between the results, means were completely separated using Duncan's Multiple Range Test of the same statistical software.

RESULTS

Ambiance parameters and nutrients composition of Leuceana experimental diets: Although the experiment was started (September to December) at the end of the rainy season, corresponding to the announcement of fresh period beginning, the ambient temperature recorded in the breeding local of birds throughout the experiment was relatively high ranging from 28.3-33.7°C, either an average of 29.49°C. The air humidity in the local, ranged between 27 and 71% with an average about of 59.3%. The nutrients composition and calculated Metabolizable Energy (ME) content of *Leuceana* experimental diets determined was reported in Table 3. All experimental diets were isonitrogenous. The *Leuceana* leaves meal inclusion had significantly ($p<0.05$) and proportionally increased the Ether Extract (EE), Crude Fiber (CF), ash and calcium contents in the diets while those of Nitrogen Free Extract (NFE) and ME were decreased. However, except for LL_{21} dietary treatment which had a relatively significant lower [ME/CP] ratio (16.95), the ME content difference between experimental diets did not affect these ratio values in LL_7 and LL_{14} (17.42) diets compared to the control (17.70).

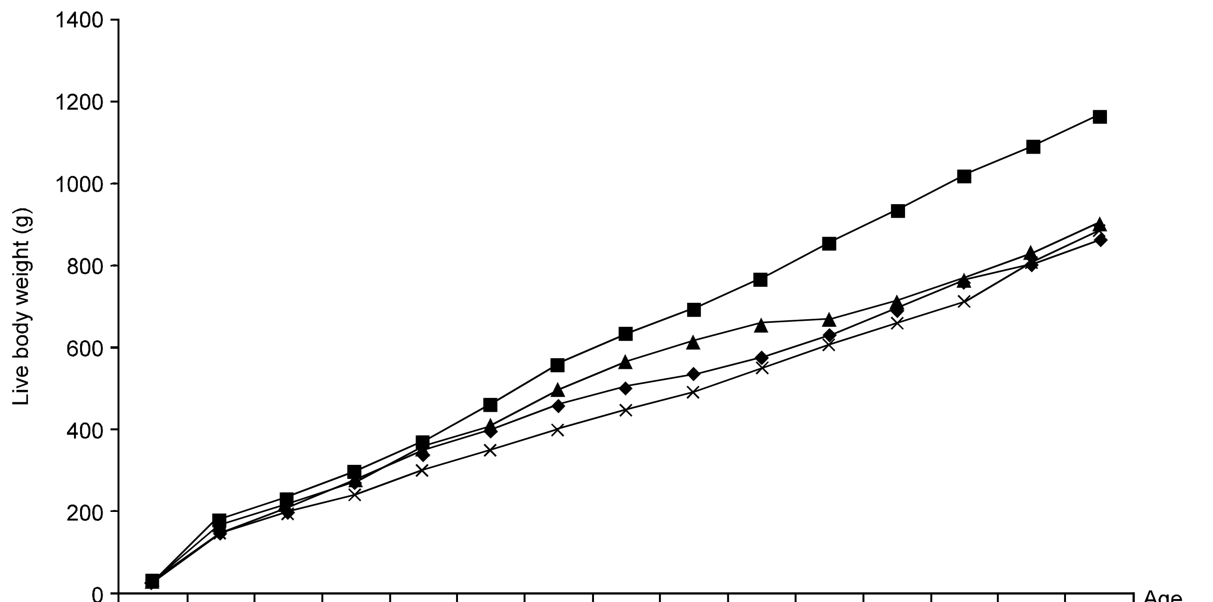
Growth performances, health status or mortality rate of indigenous Senegal chickens: The impacts of *Leuceana* leaves meal inclusion in the diets on Live Body Weight (LBW) development of growing indigenous Senegal chickens according to age are illustrated in Fig. 1. From the 4th to the 11th week of age, the LBW of birds in all dietary treatments increased similarly, with a significantly ($p<0.05$) advantage in birds fed LL_7 and LL_{14} diets. From the 12th week until the end of the experiment (17 weeks old), the significant LBW advantage was only maintained in birds fed diet containing 7% of *Leuceana* leaves meal. The LBW of birds fed the LL_{14} diet was higher but not significantly different to that of birds in other treatments LL_0 and LL_{21}. Overall, the birds in LL_7 treatment group recorded the highest LBW (1166.48 g), followed by those of LL_{14} treatment (905.02 g). The birds in control and LL_{21} treatment groups had the lowest LBW, 864.04 g and 887.16 g respectively at the end of the trial. At 4, 8, 12, 16 and 17 weeks old, the global LBW mean recorded for all indigenous birds in the trial were respectively 161.78 g, 407.78 g, 640.49 g, 885.95 g and 959.66 g (Table 4). The results of *Leuceana* leaves meal inclusion on Average Daily Weight Gain (ADWG), Daily Feed Intake (DFI), Feed Conversion Ratio (FCR) and mortality rate of growing indigenous Senegal chickens are summarized in Table 4. From one day to 4 weeks, the ADWG of birds were relatively low and were not significantly different between treatment groups. From 5 to 9 weeks old, the ADWG increased according to age and were significantly higher in birds fed diets containing 7 and 14% of *Leuceana* leaves meal

Table 3: Nutrients composition of *Leuceana Leucocephala* (LL) experimental diets for growing indigenous senegal chickens

	Dietary treatments			
Analyzed nutrients values	LL_0	LL_7	LL_{14}	LL_{21}
Number of samples	03	03	03	03
Dry matter, DM (%)	90.36 ± 0.04^{a}	90.55 ± 0.06^{ab}	90.77 ± 0.10^{b}	90.47 ± 0.25^{a}
Crude Protein, CP (% DM)	20.41 ± 0.46	20.95 ± 0.03	20.42 ± 0.15	20.90 ± 0.20
Ether extract, EE (% DM)	4.50 ± 0.25^{a}	6.78 ± 0.19^{b}	6.85 ± 0.05^{b}	7.34 ± 0.11^{c}
Crude fiber, CF (% DM)	3.40 ± 0.04^{a}	4.13 ± 0.17^{b}	5.18 ± 0.05^{c}	5.40 ± 0.03^{d}
Nitrogen Free Extract, NFE (% DM)	64.70 ± 0.29^{d}	60.68 ± 0.40^{c}	60.02 ± 0.41^{b}	58.27 ± 0.16^{a}
Total Ash (% DM)	7.02 ± 0.12^{a}	7.44 ± 0.05^{b}	7.53 ± 0.30^{b}	8.08 ± 0.18^{c}
Calcium, Ca (% DM)	0.85 ± 0.02^{a}	0.90 ± 0.05^{ab}	0.91 ± 0.02^{b}	0.99 ± 0.04^{c}
Phosphorus, P (% DM)	0.60 ± 0.02	0.62 ± 0.10	0.72 ± 0.08	0.61 ± 0.03
Metabolizable energy, ME[1] (kcal/kg DM)	3610.00 ± 15.0^{b}	3650.00 ± 7.0^{c}	3557.00 ± 6.0^{a}	3542.00 ± 11.0^{a}
ME/Protein Ratio (kcal/g)	17.70 ± 0.47^{b}	17.42 ± 0.02^{ab}	17.42 ± 0.16^{ab}	16.95 ± 0.10^{a}

^{a,b,c,d}Means within rows with different superscripts are significantly different at 5% level ($p<0.05$), LL_0: Control diet containing 0% of *Leuceana leucocephala* leaves meal; LL_7: diet containing 7% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL_{14}: diet containing 14% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL_{21}: diet containing 21% of *L. leucocephala* leaves meal in substitution of groundnut cake.

[1]ME (kcal/kg DM) = 3951 + 54.4*EE - 40.8*Ash - 88.7*CF, in (Leclercq *et al.*, 1984)



	D1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Age (weeks)
LL_0	30.79	156.6	205.2	280.2	344.9	400.6	458.4	501.3	534.9	573.5	627.1	694.0	762.7	805.3	864.0	
LL_7	30.85	176.3	227.1	294.9	367.1	461.7	558.6	633.0	694.8	767.4	854.5	936.5	1021	1092	1166	
LL_{14}	30.55	163.1	218.8	279.0	356.5	412.0	501.6	569.2	617.5	660.0	672.5	716.0	768.3	830.2	905.0	
LL_{21}	30.14	149.9	195.5	241.2	300.4	353.9	401.7	448.9	492.0	550.4	608.5	658.2	712.4	800.6	887.1	

Fig. 1: Evolution of live body weight of growing indigenous Senegal chickens fed diets containing respectively 0 (LL_0), 7 (LL_7) 14 (LL_{14}) and 21% (LL_{21}) of *L. leucocephala* leaves meal according to age

compared to other treatment groups. From 10 to 17 weeks of age, the *Leuceana* leaves meal inclusion in the diets significantly improved ($p<0.05$) the ADWG of growing indigenous chickens, particularly in birds fed LL_7 and LL_{21} diets compared to others. For all the trial period, *Leuceana* leaves meal inclusion significantly increased the ADWG of chickens in LL_7 dietary treatment. The ADWG recorded were 7.77, 10.88, 8.15 and 8.10 g/day respectively for birds in LL_0, LL_7, LL_{14} and LL_{21} dietary treatment groups; the global ADWG mean was 8.76 g/day. The increasing rate of ADWG were 40%, 4.90% and 4.25% respectively in birds fed LL_7, LL_{14} and LL_{21} diets compared to the control treatment birds which showed the lowest ADWG. At one, two, three and four months of age, the global ADWG of all indigenous chickens in this trial were respectively 3.75, 9.13, 7.58

Table 4: Effects of various levels of *Leuceana leucocephala* leaves meal inclusion in the diets on growth performances and mortality of indigenous senegal chickens

	Dietary treatments						
Chickens parameters	LL_0	LL_7	LL_{14}	LL_{21}	Global mean	SEM	p-value
Initial number of birds/treatment	26.00	26.00	26.00	26.00	104.00	-	-
Body weight at day one, D_1 (g)	30.78±3.37	30.85±3.98	30.56±4.63	30.14±3.48	30.58±3.86	0.38	0.915
Body weight at 4 weeks old (g)	156.59±44.25	176.38±32.95	163.50±50.28	149.98±43.27	161.78±43.51	4.37	0.163
Body weight at 8 weeks old (g)	400.61±129.03^{ab}	461.77±122.23^{b}	412.02±137.56^{ab}	353.98±128.54^{a}	407.78±133.26	13.39	0.035
Body weight at 12 weeks old (g)	573.57±162.12^{a}	767.44±201.03^{b}	660.06±213.85^{a}	550.48±161.69^{a}	640.49±203.23	20.42	0.000
Body weight at 16 weeks old (g)	805.33±223.50^{a}	1092.87±196.13^{b}	830.24±216.40^{a}	800.66±200.64^{a}	885.95±240.60	24.18	0.000
Body weight at 17 weeks old (g)	864.04±233.86^{a}	1166.48±204.53^{b}	905.02±224.34^{a}	887.16±225.10^{a}	959.66±251.55	45.02	0.000
ADWG 0-4 weeks old (g/day)	3.60±1.18	4.16±0.84	3.79±1.36	3.42±1.14	3.75±1.16	0.12	0.130
ADWG 5-9 weeks old (g/day)	8.62±3.22^{ab}	10.92±3.65^{c}	9.67±4.35^{bc}	7.19±3.36^{a}	9.13±3.88	0.39	0.004
ADWG 10-13 weeks old (g/day)	6.02±2.01^{a}	10.56±1.79^{c}	6.11±2.61^{a}	7.38±2.31^{b}	7.58±2.86	0.29	0.000
ADWG 14-17 weeks old (g/day)	8.46±3.10^{a}	11.14±3.62^{b}	8.30±2.90^{a}	9.95±2.91^{ab}	9.50±3.32	0.33	0.005
ADWG 5-17 weeks old (g/day)	7.77±2.26^{a}	10.88±1.98^{b}	8.15±2.25^{a}	8.10±2.19^{a}	8.76±2.49	0.25	0.000
DFI 5-9 weeks old (g/bird/day)	38.46±0.24^{a}	43.80±6.90^{b}	40.76±11.00^{ab}	37.78±3.56^{a}	40.27±7.11	0.72	0.010
DFI 10-13 weeks old (g/bird/day)	37.86±3.29^{a}	50.62±0.76^{c}	39.16±5.52^{a}	42.13±1.76^{b}	42.61±6.02	0.60	0.000
DFI 14-17 weeks old (g/bird/day)	43.63±6.15^{b}	60.58±3.67^{d}	41.19±1.72^{a}	56.07±0.05^{c}	50.61±8.98	0.90	0.000
DFI 5-17 weeks old (g/bird/day)	39.86±2.81^{a}	51.06±1.29^{c}	40.39±6.46^{a}	44.75±1.90^{b}	44.17±5.83	0.58	0.000
FCR 5-9 weeks old	5.57±1.77^{ab}	4.67±1.19^{a}	5.59±2.45^{ab}	6.77±2.97^{b}	5.64±2.30	0.23	0.011
FCR 10-13 weeks old	8.53±3.24^{c}	5.79±1.48^{a}	7.55±2.23^{bc}	6.75±3.58^{ab}	7.11±2.88	0.29	0.006
FCR 14-17 weeks old	7.39±2.55^{b}	6.37±1.78^{ab}	5.85±1.98^{a}	6.89±2.24^{ab}	6.61±2.19	0.22	0.081
FCR 5-17 weeks old	7.04±2.10^{b}	5.54±0.96^{a}	6.27±1.41^{ab}	6.80±2.16^{b}	6.39±1.78	0.18	0.013
Final number of birds/treatment	23.00	26.00	25.00	25.00	99.00	-	-
Mortality rate (%)	11.54^{c}	0.00^{a}	3.85^{b}	3.85^{b}	4.81	1.08	0.000

^{a,b,c,d}Means within rows with different superscripts are significantly different at 5% level ($p<0.05$). LL_0: Control diet containing 0% of *Leuceana leucocephala* leaves meal; LL_7: diet containing 7% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL_{14}: diet containing 14% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL_{21}: diet containing 21% of *L. leucocephala* leaves meal in substitution of groundnut cake. ADWG: Average daily weight gain; DFI: Daily feed intake; FCR: Feed Conversion Ratio

and 9.50 g/day. The *Leuceana* leaves meal inclusion in the diets significantly increased daily feed intake (DFI), particularly in birds fed LL_7 and LL_{14} diets from 5 to 9 weeks old and in birds fed LL_7 and LL_{21} from 10 to 17 weeks age compared to others. From the 5th until the end of the trial, the DFI were significantly higher ($p<0.05$) for birds in LL_7 (51.06 g) followed by those in LL_{21} (44.75 g/bird) than those of LL_0 (39.86 g) and LL_{14} (40.4 g/bird) treatment groups. The increasing rate of DFI were respectively 28.1%, 1.35% and 12.27% for LL_7, LL_{14} and LL_{21} dietary treatments compared to the DFI of birds in control treatment (LL_0).

From the 5th to the 9th week of age, the Feed Conversion Ratio (FCR) significantly increased with the *Leuceana* leaves meal inclusion in the diets. From 10 to 17 weeks old, the FCR in birds fed *Leuceana* leaves based diets increased without being significantly different to that of the control. For all the trial period, the inclusion of *Leuceana* leaves meal had no significant adverse effects on FCR of growing indigenous Senegal chickens in different dietary treatments. It had significantly reduced ($p<0.05$) the FCR in birds fed LL_7 (5.54) and LL_{14} (6.27) compared to the control (LL_0) and LL_{21} treatments birds which had similar FCR of 7.04 and 6.80 respectively; the global FCR mean was 6.39. The decreasing rate of FCR were 21.42%, 10.92% and 3.55% in birds fed diets containing respectively 7, 14 and 21% of *Leuceana* leaves meal compared to the control birds. From 5 to 17 weeks of age, the *Leuceana* leaves meal inclusion in the diets had no adverse effect on health and mortality of indigenous chickens. It would rather reduce the mortality rate of birds compared to the control group. During the 13 weeks of experimentation, a total of five (5) mortalities (4.81%) were recorded. The first (3.85%) and the second (3.85%) were occurred at 6 and 7 weeks old respectively in birds receiving LL_{14} and LL_{21} dietary treatments. Their autopsy revealed a great suspicion of chicks' ascites syndrome which original causes are not well known. Any mortality was not recorded among indigenous chickens in LL_7 dietary treatment group. The three (3) other deaths (11.54%) were recorded in birds fed the control diet (LL_0) and were caused by the respiratory tract parasites, *Syngamus trachei*. Indeed, before dying, the birds had often yawned and lesions and eggs of these parasites were observed in the lungs and in trachea of chickens in autopsy (Fig. 2).

Carcass and organs characteristics and economics results of indigenous Senegal chickens: The results related to the effects of *Leuceana* leaves meal inclusion in the diets on carcass and organs characteristics and economic margins of growing indigenous Senegal chickens are summarized in Table 5. The inclusion of *Leuceana* leaves meal significantly increased ($p<0.05$) carcass weight in birds fed LL_7 diet compared to others. It had no adverse effect on dressing carcass, liver weight, heart weight, lungs and spleen weights which were all increased in birds fed *Leuceana* leaves based diets without being significantly different between treatments compared to the control group. But, taken together, the weight of all these organs (liver, heart, lungs and spleen) was significantly increased ($p<0.05$) with the *Leuceana* leaves meal inclusion in the diets.

Fig. 2: Lesions in lungs (left and medium pictures) and eggs in trachea (right picture) of Syngamus trachei, a respiratory parasite tract observed in growing indigenous Senegal chickens fed the control diet

Table 5: Effects of various levels of *Leuceana leucocephala* leaves meal inclusion in the diets on carcass and organs characteristics and economics results of growing indigenous Senegal chickens

	Dietary treatments						
Parameters	LL$_0$	LL$_7$	LL$_{14}$	LL$_{21}$	Global mean	SEM	p-value
Birds killed/treatment	6.00	6.00	6.00	6.00	6.00	-	-
Carcass and organ characteristics							
Average body weight of bird (g)	832.40±152.76^{a}	1129.40±70.98^{b}	867.40±70.30^{a}	905.00±60.35^{a}	933.55±148.10	33.11	0.001
Average Carcass weight (g)	731.80±116.70^{a}	954.60±67.20^{b}	743.80±75.17^{a}	788.20±77.69^{a}	804.60±120.98	27.05	0.003
Dressing (%)	88.19±2.39	84.50±1.26	85.64±2.02	86.97±3.67	86.33±2.69	0.60	0.145
Liver weight, LW (g)	19.40±2.19	27.00±6.12	24.80±6.42	26.00±2.12	24.30±5.25	1.18	0.087
Heart weight, HW (g)	5.40±1.14	6.20±0.84	4.80±0.44	6.00±0.71	5.60±0.94	0.21	0.064
Lungs +Spleen weight, LSW (g)	9.60±3.21	13.00±4.18	9.60±1.82	12.80±1.48	11.25±3.14	0.70	0.130
LW + HW + LSW (g)	34.40±5.50^{a}	46.20±5.98^{b}	39.20±5.93^{ab}	44.80±3.96^{b}	41.15±6.92	1.55	0.012
(LW + HW + LSW)/ABW ratio (%)	4.15±0.11^{a}	4.09±0.41^{a}	4.53±0.72^{ab}	4.95±0.32^{b}	4.43±0.54	0.12	0.026
Yellow color score of skin	1.16±0.44^{a}	1.40±0.54^{a}	1.80±0.83^{a}	3.16±1.30^{b}	1.90±1.12	0.25	0.008
Yellow color score of abdominal fat	1.16±0.44^{a}	1.60±0.54^{ab}	2.20±0.84^{bc}	3.34±0.70^{c}	2.09±0.92	0.21	0.003
Economic results							
Experimental feed price (FCFA[1]/kg)	176.00	182.00	185.00	188.00	183.00	-	-
Feed cost/bird, 5-17 weeks old (FCFA)	1033±190	1139±72	1009±82	1157±77	1084±128	28.0	0.147
Feed cost/kg carcass (FCFA)	1408±38^{b}	1193±18^{a}	1359±32^{b}	1472±60^{c}	1358±112	25.0	0.000
Selling price/kg carcass (FCFA)	2000.00	2000.00	2000.00	2000.00	2000.00	-	-
Selling price/bird carcass (FCFA)	1464±233^{a}	1909±134^{b}	1488±150^{a}	1576±155^{a}	1609±242	54.0	0.003
Gross margin food/bird (FCFA)	431±48^{a}	770±66^{b}	478±70^{a}	419±87^{a}	525±160	36.0	0.000
Gross margin food/kg carcass (FCFA)	592±38^{b}	807±18^{c}	641±32^{b}	528±60^{a}	642±112	25.0	0.000
SNM/kg carcass[2] (FCFA)	0.00^{ab}	214±49^{c}	48±49^{b}	-64±91^{a}	50±118	26.0	0.000

^{a,b,c,d}Means within rows with different superscripts are significantly different at 5% level ($p<0.05$). LL$_0$: Control diet containing 0% of *Leuceana leucocephala* leaves meal; LL$_7$: diet containing 7% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL$_{14}$: diet containing 14% of *L. leucocephala* leaves meal in substitution of groundnut cake; LL$_{21}$: diet containing 21% of *L. leucocephala* leaves meal in substitution of groundnut cake. FCFA[1]: Money of the French Community of Africa, 1€ = 655.957 FCFA.
SNM[2]: Supplementary Net Margin generated in comparison to the control diet LL$_0$

This increasing of organs weight was not proportional to the live body weight of chickens, the ratio [organs weight/LBW] was significantly increased ($p<0.05$) with the leaves meal inclusion compared to the control. Moreover, the incorporation of *Leuceana* leaves meal in the diets had produced significantly and proportionally yellow coloration of the skin (Fig. 3) and abdominal fat (Fig. 4) of carcasses in traditional chickens compared to the control treatment. As for economic results, the price per kilogram of feed had increased with the level of *Leuceana* leaves meal inclusion. It was evaluated at 176, 182, 185 and 188 FCFA/kg respectively for LL$_0$, LL$_7$, LL$_{14}$ and LL$_{21}$ diets. The feed cost per kg carcass obtained was significantly lower in birds receiving LL$_7$ diet than those of other treatment groups. Birds fed the

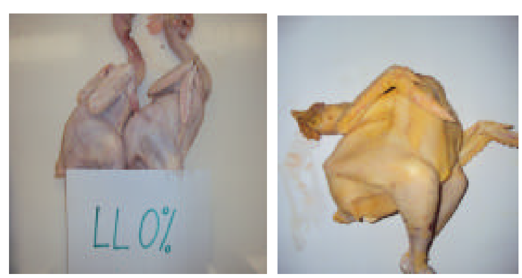


Fig. 3: Normal color (left picture) and intense yellow color (right picture) of skin of carcasses from growing indigenous Senegal chickens fed diets containing respectively 0% (LL$_0$) and 21% (LL$_{21}$) of *Leuceana leucocephala* leaves meal

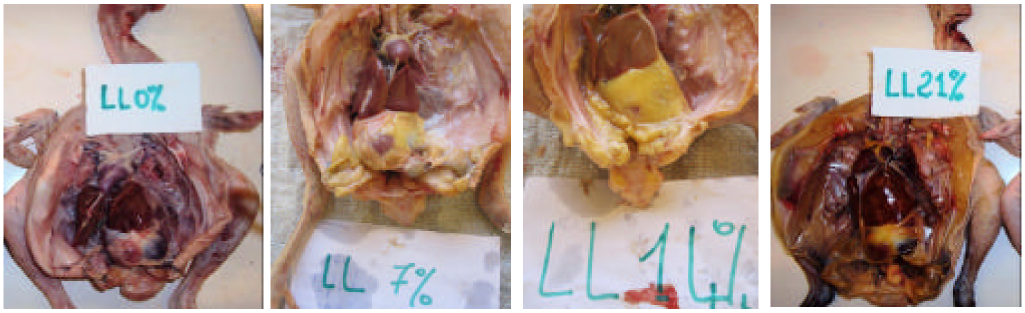


Fig. 4: Normal, yellow, intense yellow and dark yellow color of abdominal fat of carcasses (from left to right pictures) from growing indigenous Senegal chickens fed diet containing respectively 0% (LL$_0$), 7% (LL$_7$), 14% (LL$_{14}$) and 21% (LL$_{21}$) of *Leuceana leucocephala* leaves meal

diet containing 21% of *Leuceana* leaves had recorded the highest feed cost (1472 FCFA/kg carcass) while the lowest (1193 FCFA/kg carcass) was obtained in LL$_7$ dietary treatment, followed by LL$_{14}$ (1359 FCFA/kg carcass) and LL$_0$ (1408 FCFA/kg carcass) treatments. For a selling price of 2000 FCFA/kg carcass, the Gross Margin Food (GMF)/kg carcass generated per dietary treatment was significantly higher for birds in LL$_7$ diet (807 FCFA/kg carcass), followed by LL$_{14}$ (641 FCFA/kg carcass) and LL$_0$ (592 FCFA/kg carcass) treatments. Birds in LL$_{21}$ dietary treatment had recorded the lowest GMF value (528 FCFA/kg carcass). Compared to the control dietary treatment, the LL$_7$ and LL$_{14}$ treatments had allowed achieving respectively an additional net margin of 214 and 48 FCFA/kg carcass while the LL$_{21}$ treatment had resulted in a loss of 64 FCFA/kg carcass (Table 5). From these results, it can be noted that apart from the dark yellowing of abdominal fat, the inclusion of *Leuceana* leaves meal up to 21% in the diet, had no adverse effect on carcass and organs characteristics of growing indigenous Senegal chickens and was more economically profitable at the rate of 7 and 14% inclusion in comparison to the control.

DISCUSSION

The temperature recorded (28.3-33.7°C) in this study was higher than that (19-27°C) recommended by Bordas and Minvielle (1997), Rekhis (2002) and ITAVI (2003), but similar to that obtained (26.7-33.1°C) in Senegal by Bello (2010). Although the humidity (27-71%) was in agreement with that usually recommended (40-70%), it was lower than that measured (51-84%) by Bello (2010). This relatively low humidity value recorded could be explained by the fact that Bello (2010) had undertaken his trial from July to October which corresponded to the rainy season, a particularly hot and wet period in Senegal. The significantly higher Ether Extract (EE) content recorded in *Leuceana* leaves based diets than the control may be explained by the increasing contribution of ground nut oil in the diets with the incorporation of *Leuceana* leaves meal. But, these latter being richer in Crude Fiber (CF) and less energetic (Ayssiwede *et al*., 2010b), their gradual inclusion had significantly increased the CF content and consequently decreased the Metabolizable Energy (ME) content of the diets despite the ground nut oil inclusion. The significant reduction of [ME/CP] ratio, particularly in LL$_{21}$ diet, would probably due to its low ME content.

For all experimental period (5-17 weeks of age), the inclusion of *L. leucocephala* leaves meal in the diets had no significant adverse effects on Live Body Weight (LBW), Average Daily Weight Gain (ADWG), Daily Feed Intake (DFI), Feed Conversion Ratio (FCR) and mortality of growing indigenous Senegal chickens compared to the controls. It had significantly improved ($p<0.05$) the LBW, ADWG, DFI and FCR of birds, particularly in LL$_7$, and to a lesser extent in LL$_{14}$ dietary treatments compared to others. These results are supported by the findings of Ross and Springhall (1963), Springhall and Ross (1965) and D'Mello and Acamovic (1982) in which they had demonstrated the improvement of ADWG, DFI and FCR by incorporating in the broiler or laying chickens' diets, 15-20% of *Leuceana* leaves meal treated with ferrous sulphate. Apart from the significant decrease of ADWG and FCR recorded by Pojun *et al.* (1989) and Hussain *et al.* (1991) at 20% inclusion of *Leuceana* leaves meal in the diets of broiler chickens; our results are similar to those of these least authors. Moreover, they are confirmed those previously recorded by Ayssiwede *et al.* (2010b) in which the inclusion of *Leuceana* leaves meal up to 21% in the diet of adults indigenous Senegal chickens had no adverse effect on DFI, ADWG and FCR and had significantly improved the apparent coefficients of nutrients and ME utilization, certainly in birds fed diets containing 7 and 14% of these leaves meal. Similar results were also obtained by Kakengi *et al.* (2007), Tendonkeng *et al.* (2008) and Olugbemi *et al.* (2010a) with 6-20% inclusion of *Moringa* leaves, Ravindran *et al.* (1983) with cassava leaves meal, in which the DFI had significantly increased in broilers and laying birds. However, our results are in disagreement with those obtained by including 15-30%

of *Leuceana* leaves (Ter Meulen *et al*., 1984; D'Mello *et al*., 1987; Satyanarayana *et al*., 1987; Bhatnagar *et al*., 1996; Mutayoba *et al*., 2003; Atawodi *et al*., 2008; Onibi *et al*., 2008) or 5-20% of *Gliricidia sepium* leaves meal (Osei *et al*., 1990; Odunsi *et al*., 2002) in the diets of broiler chickens and laying hens. It is the same with the findings of Gupta *et al*. (1970) for 10% inclusion of *Cassia tora* leaves, Suliman *et al*. (1987) for 5% of fermented *C. tora* leaves, Ravindran *et al*. (1986), Iheukwumere *et al*. (2008) and Onibi *et al*. (2008) for 10-20% inclusion of cassava (*Manihot esculenta*) leaves meal in the diets, in which they observed a significant decrease in chickens growth performances. The low performances obtained with *Leuceana* (Ter Meulen *et al*., 1984; D'Mello, 1992; Bhatnagar *et al*., 1996; Atawodi *et al*., 2008), *Gliricidia* (Odunsi *et al*., 2002) or *Cassia* leaves meal (Gupta *et al*., 1970) were attributed by authors to anti-nutritional factors, especially mimosine, tannins or nitrates-nitrites. The performances improvement noted in our study could arise then from the fact that the *Leuceana* leaves meal used were treated with ferrous sulphate as doing D'Mello and Acamovic (1982) or Springhall and Ross (1965) to neutralize mimosine, the main toxic factor of *L. leucocephala*, unlike to the studies of these previous authors. The low DFI observed in birds fed LL_{14} and LL_{21} diets compared to LL_7 diet may be caused by the high crude fiber content or palatability of the diets. According to Ash and Petaia (1992) and Omekam (1994), chickens did not eat voluntarily fresh or dried legumes leaves and could often showed a decline in their performances, particularly DFI due to the high fiber content or lack of appetite when fed diet containing high level of leaves meal.

The Live Body Weight (LBW) means of 162 g (150-176 g), 408 g (354-462 g), 640.5 g (550-767 g) and 886 g (801-1093 g) globally recorded respectively at 4, 8, 12 and 16 weeks old for indigenous chickens are consistent with those obtained in station in Cameroon and Congo (119-212, 384-511, 467-622 , 782-1102 g) by Fotsa (2008) and Akouango *et al*. (2010), in Senegal (158-185, 525-617, 718-847 and 954-1040 g) by Ali (2001) and in Nigeria (191, 480, 821 and 1035 g) by Adebanjo and Oluyemi (1981). The relatively higher LBW (800-838 g and 1677-1724 g) were found in Kenya respectively at 12 and 19 weeks of age by Ndegwa *et al*. (2001). However, our LBW in this study were higher than those obtained at the same ages (90-146, 242-358, 381-588 and 541-847 g) in Senegal (Missohou *et al*., 2002; Bello, 2010), Tanzania (Msoffe *et al*., 2004), Nigeria (Adedokun and Sonaiya, 2001; Fayeye *et al*., 2005) and in Ethiopia (Halima *et al*., 2007b). The LBW mean of 960 g (864-1166 g) obtained is higher than that (720-912 g) found in Senegal (Bello, 2010) and in Burkina Faso (Pousga *et al*., 2006) at 17 weeks old and in Sudan (600-783 g) at 18 weeks of age by Mohammed *et al*. (2005). The Average Daily Weight Gain (ADWG) mean, 8.76 g/day (7.77-10.88) obtained in traditional chickens in our study is in agreement with those recorded (7-12 g/day) in Nigeria (Adebanjo and Oluyemi, 1981) and in Cameroon (Fotsa, 2008). However, it remained higher than those (5-9 g/day) found by most authors (Buldgen *et al*., 1992; Adedokun and Sonaiya, 2001; Ali, 2001; Msoffe *et al*., 2004; Pousga *et al*., 2006; Halima *et al*., 2007b; Akouango *et al*., 2010; Bello, 2010). These variations could be explained not only by feeding or breeding conditions, geographical or seasonal differences of areas, but also by age, sex, diversity or genetic variability existence in the indigenous African chickens' population. Our experiment birds containing some crosses from blue Holland cockerels and local hen, the ADWG was often higher in crosses or males' chickens than in pure local breeds or females, lower in scavenging birds than housed and regularly fed birds (Buldgen *et al*., 1992; Pousga *et al*., 2006; Halima, 2007). It was also shown that indigenous chickens with such fast fledge grow slower than slow ones fledge (Fotsa, 2008).

The Daily Feed Intake (DFI) mean 44.2 g/jour (39.8-51 g/jour) obtained from the 5th until the end of the trial (17 weeks old) is consistent with those recorded by Buldgen *et al*. (1992), Fall and Buldgen (1996), Pousga *et al*. (2006) and Halima *et al*. (2007b). It remains relatively higher than that obtained (34-40 g/day) by Bello (2010) and lower than those found by Ali (2001) and Ayssiwede *et al*. (2010a and 2010b). Indeed, the DFI of village chickens from 0-24 weeks of age was ranged from 5 to 98 g/day (Buldgen *et al*., 1992; Halima *et al*., 2007b) while from 6 to 17 weeks of age; it was about of 36-48 g/day (Fall and Buldgen, 1996; Pousaga *et al*., 2006; Halima *et al*., 2007b). The DFI varies according to age, ambient temperature, nature and energy level of the diets. In adults village chickens, it was higher, 62-72 g of medium to high-energy (2600-3000 kcal ME/kg DM) diets and 88 g/day of low-energy (2400 kcal ME/kg DM) diet with a Feed Conversion Ratio (FCR) respectively about of 5.6-7.4 and 12.8 (Ali, 2001; Ayssiwede *et al*. 2010a and 2010b). The FCR recorded 6.39 (5.54-7.04) in this study is globally similar to those obtained by most authors (Buldgen *et al*., 1992; Pousga *et al*., 2006; Ayssiwede *et al*., 2010a and 2010b; Bello, 2010; Ossebi, 2010). But it is relatively higher than that (3.9-5) recorded by Fotsa (2008) in Cameroon, and lower than those found (7.4-12.8) by Ali (2001) in Senegal and Halima *et al*. (2007b) in Ethiopia by providing ordinary feed to these birds.

The *Leuceana* leaves meal inclusion in the diets had significantly improved carcass weight in birds fed LL_7 diet. Despite the significantly improvement of [whole organs weight/LBW] ratio noted with the *Leuceana* leaves meal inclusion, this least globally had no adverse effect on dressing carcass, liver weight, heart weight, lungs and spleen weight compared to the control. Dressing carcass obtained 86.3% (84.5-88.2%) in this study is higher than those obtained in Senegal (67-79%) by Buldgen *et al.* (1992), Ali (2001) and Bello (2010), in Congo (71.5-78.4%) by Akouango *et al.* (2010), in Burkina (66-80%) by Kondombo (2005) and in Nigeria, Ethiopia and Cameroon (54-68.5%) by Adebanjo and Oluyemi (1981), Joseph *et al.* (1992), Halima *et al.* (2007b) and Fotsa (2008). The liver weight 24.3 g (19-27 g), heart weight 5.6 g (4.8-6.2 g), lungs and spleen weight 11.25 g (9.6-13 g) obtained in this study, are higher than those respectively (21.80 g, 3.75 g, 6.55 g) recorded by Bello (2010) at 17 weeks old and by Fotsa (2008) at 16 weeks of age. These variations could be due to age or live body weight, sex of birds, type of carcass, chicken ecotypes or seasons. Cockerels often having higher Dressing Carcass (DC) than hens, the prevalence of male chickens in groups can increase the DC mean and reciprocally. Also, organs development is often proportional to live body weight or age. Kondombo (2005) had shown that the DC of traditional chickens slaughtered in dry season was higher than that of birds killed in rainy season. Moreover, *Leuceana* leaves meal inclusion had produced significantly and proportionally yellow coloration of skin and abdominal fat of carcasses of growing traditional chickens compared to the control treatment. According to the ecotypes of indigenous chickens, white (44%), pink (22%), yellow (28%) or black (7%) pigments of skin of carcasses were reported by Moula *et al.* (2009) in Algeria. However, the yellowing of the skin, abdominal fat or egg yolk may be influenced by the diet composition in xanthophylls pigments (Talpin *et al.*, 1981; D'Mello *et al.*, 1987; Surai *et al.*, 2001; Agbede and Aletor, 2003). The yellowing observed in our study indicates that *Leuceana* leaves are rich in pro-vitamins A or carotenoids pigments which were efficiently absorbed and utilized by the birds. This observation is supported by the findings of Talpin *et al.* (1981), Quang Hien and Duc Hung (1998) or Onibi *et al.* (2008), in which the *Leuceana* or *cassava* leaves meal inclusion about 6-20% in the diet of broiler or laying chickens had significantly produced yellowing of the skin, shanks, abdominal fat and egg yolk. Similar results were recorded by Kaijage *et al.* (2003), Bello (2010) and Olugbemi *et al.* (2010a and 2010b) with the inclusion of 10-24% of *Moringa* leaves meal in the diets of laying hens, indigenous or broiler chickens.

Unlike to Onibi *et al.* (2008), our feed price/kg diet, increased with the inclusion level of *Leuceana* leaves meal in the diets, ranging from 176 FCFA/kg (control diet) to 188 FCFA/kg (LL_{21} diet). This controversy could arise from the fact that Onibi *et al.* (2008) had excluded the opportunity cost of harvesting and processing of leaves. However this price was lower than that practiced (240-280 FCFA/kg) in Senegalese markets for the industrial poultry feed. For all the experimental period, except the LL_7 treatment which had the significantly lowest feed cost (1193 FCFA/kg carcass), followed by LL_{14} (1359 FCFA/kg carcass) and control (1408 FCFA/kg carcass), the feed cost was significantly higher, 1472 FCFA/kg carcass in LL_{21} treatment group. As a result, Gross Margin Food (GMF)/kg carcass was significantly higher in LL_7 treatment (807 FCFA) and decreased with the rate of *Leuceana* leaves meal in the diets, 641 and 528 FCFA/kg carcass respectively in LL_{14} and LL_{21} while that of the control was 592 FCFA/kg carcass. Thus, compared to the control, the LL_7 and LL_{14} dietary treatments had allowed realizing respectively a Supplementary Net Margin (SNM) of 214 and 48 FCFA/kg carcass while the LL_{21} treatment had resulted a loss of 64 FCFA/kg carcass. These results are in line with those obtained by Quang Hien and Duc Hung (1998) and Quang Hien and Thi Inh (1998) in which the inclusion of 5-6% of *Leuceana* leaves treated with ferrous sulphate in the diets had significantly reduced the feed costs/kg LBWG or egg produced respectively in broiler and laying chickens. Although our results are corroborated those obtained by Bello (2010), these additional net margins were remained lower than those found by this author at 8 and 16% inclusion of *Moringa oleifera* leaves meal in the diets of these birds. They are also supported by the findings of Onibi *et al.* (2008) in Nigeria or Tendonkeng *et al.* (2008) in Cameroon in which the feed costs/kg LBWG of broiler chicken finishers were increased with *Leuceana* or *Moringa* leaves meal inclusion in the diets. The increasing of feed price and feed costs along with the reduction of economic margins could be explained by the influence of the high price of groundnut oil incorporated, the opportunity cost of leaves harvesting and processing and the increasing of Feed Conversion Ratio (FCR) recorded with *Leuceana* leaves meal inclusion.

Conclusion: The incorporation of *Leuceana leucocephala* leaves meal up to 21% in the diets of growing traditional Senegal chickens had no adverse effects on live body weight, average daily weight gain, daily feed intake, feed conversion ratio, health and mortality rate, carcass and organs characteristics in birds compared to their controls. A part from the dark yellowing of abdominal fat of carcasses observed in birds fed LL_{21} diet, significantly better growth performances, feed costs and economic margins were recorded in growing indigenous chickens fed diet containing 7% and 14% of *Leuceana* leaves meal, making these two dietary treatments the most economically profitable. Considering these results and the high price of raw ordinary ingredients, particularly protein ingredient sources in poultry feeding; the recovering of these leguminous leaves in the diets of village chickens is a real opportunity for traditional stockholders to improve at lower cost, not only the productivity and nutritional status of their birds, but also their income.

ACKNOWLEDGEMENTS
The authors are grateful to the National Fund of Agricultural and Food Research (FNRAA) of Senegal for financing this study and to the University Agency of French-speaking world (AUF) for its financial assistance.

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