Journal homepage: www.fia.usv.ro/fiajournal
Journal of Faculty of Food Engineering,
Ştefan cel Mare University of Suceava, Romania
Volume XV, Issue 3- 2016, pag. 240 - 248

# TRADITIONAL LEAFY VEGETABLES COMBINATIONS ENHANCE GROWTH PERFORMANCE AND IMPROVE HEALTH STATUS OF NEW ZEALAND WHITE x CALIFORNIAN RABBITS

**Franck K.YAO[1], ∗Athanase K. OTCHOUMOU[1], Raïssa M.F.L. WOGNIN[1], Sébastien NIAMKE[1]**

[1]*Laboratoire de Biotechnologies, UFR Biosciences, Université Félix Houphouët-Boigny, 22 BP 582, Abidjan 22, Côte d'Ivoire.*
tchoumou2@yahoo.fr
∗Corresponding author
Received August 25th 2016, accepted September 28th 2016

**Abstract:** *Fifty five rabbits (35 days old; average initial body weight: 550g) were used to assess their growth performance and health status when they were fed with leafy vegetables combinations (Vigna unguiculata, Abelmoschus esculentus, Ipomoea batatas, Solanum melongena, Corchorus olitorius). Ten treatments composed of 50% (dry matter) of three leafy vegetables combination and 50% of pellet were given to rabbits until 98 days of age. The control treatment contained only commercial pellets (100%).*
*The results showed that the daily weight gain and the body weight gain did not differ between treatments. However, the final weights (1866.94-2200 g) were significantly different (p<0.05).Average daily feed intake (61.55 g/day) and feed conversion ratio (2.69) of the control group were different (P< 0.05) to those obtained with the other diets. However, the daily feed intake (162.10-188.97g/day) and the feed conversion ratio (6.91-8.21) of rabbit fed with leafy vegetables combination were similar (P< 0.05). Apparent coefficient of dry matter digestibility (70.52-86.21%) and of protein digestibility (86.28-91.30%) differed between treatments (P< 0.05). The digestibility of diets supplemented by mixture of Corchorus olitorius, Vigna unguiculata and Abelmoschus esculentus, was better compared to other treatments. The blood parameters tested did not differ between treatments (P>0.05), except for Low Density Lipoprotein which was high for diet F group and low for diet I group.*
*This work revealed thatthe use of leafy vegetables combination facilitated the digestibility of diets contributing therefore to the improvement of growth performance and rabbits' health status.*

**Keywords:** *Leafy vegetables, growth, blood chemistry, haematological analysis, rabbit*

## 1. Introduction

Rabbit is one of the most prolific breeders among the livestock species [1]. Rabbit meat is as nutritious as chicken and can serve as an excellent source of low cholesterol meat that is generally recommended to consumers [2]. In spite of having less space requirement, high production and reproduction potential of rabbit, its rearing has not got much tremendous popularity among the Ivorian people. This situation can be due to fact that the rabbit meat is considered as food of rich persons in Côte d'Ivoire. Moreover the high feeding cost has favored this situation as in most African countries [3].
The current trend in the breeding area is the utilization of vegetal raw for feeding the animals. Products animal are more expensive and unavailable while the vegetal products are low expensive and available. Among the vegetal raw product, the non-conventional feed as green forages are essential to reduce the feeding cost for economy production. One of the advantages of rabbit production in tropical countries is that rabbits are herbivorous animals and can be fed with forages and agricultural by-products that are not

suitable for human consumption. Besides, most studies showed that the using of green forages in the rabbit feeding facilitate the digestive transit enhancing the appetite of rabbits to obtain optimum growth and good health [4-5]. The leafy vegetables as *Vigna unguiculata, Abelmoschus esculentus, Ipomoea batatas, Solanum melongena and Corchorus olitorius* are available in abundance and under consumed by Ivorian people [6-7]. They have good nutritive characteristics [8-9-10]. The leaves of these plants were efficiently used by the rabbits for best growth performances when they were associated with 50 % of pelleted diet as showed by [5]. Indeed, the combination of two leaves allowed the assimilation of nutrients for the growth, which could have a beneficial effect on the quality of rabbit meat. Nevertheless, the studies on concentrate diet supplemented with the combination of leafy vegetables are very scantly. Therefore, the present experiment was conducted in order to investigate the effect of various combinations of three forages chosen between *Vigna unguiculata, Abelmoschus esculentus, Ipomoea batatas, Solanum melongena, Corchorus olitorius* supplemented with concentrate diet on growth performances and health status of weaned rabbits.

## 2. Materials and methods

### *Experimental Animal and Management*

The study has been conducted in a traditional rabbit farm in Bingerville municipality (Côte d'Ivoire). The study area is located between 5° 21'708 "North latitude and 3° 54'639" longitude west.
The animal (550 ±34g) were cross bred New Zealand × California rabbits [11], which weaned at 35 days of age and were housed individually in cage in wire-netting (70 × 40 × 50 cm) raised from 80 cm to ground. The cages were arranged in stripes and under the shade of large trees (natural ventilation and daylight). The average temperature recorded during the experimental period was 29±2°C. Water was provided *ad libitum*. The drinking and feeding bowl were made of removable metal cans stainless tied with binding wire to inner side of the cage.

### *Feeding of Experimental Animals*

Five traditional leafy vegetables of Côte d'Ivoire as *Vigna unguiculata, Abelmoschus esculentus, Ipomoea batatas, Solanum melongena* and *Corchorus olitorius* were used (Table1). These forages distributed to animals were purchased daily from the market at 7am and disinfected 24 h before distribution. The forage was immersed in 10 L of water containing 2 ml of bleach Lacroix®. It was then allowed to dehydrate at room temperature for 24 h [12]. A concentrate diet from Ivograin® (Industrial Zone-Yopougon-01 BP 1664 Abidjan 01-Ivory Coast was purchased. Website: www.sipra.ci) covering the nutritional needs of the growing rabbit was used as control diet (Table 1).
After weaning at 35 days, fifty five rabbits (550 ± 34 g) were housed individually in cages. The animals were acclimated to the experimental conditions during seven days [13]. The control diet was composed solely of concentrate, the other diets were composed of 50% forage (composed of three leaves) and 50% concentrate diet (control diet) (Table 2).

**Table 1**

**Approximate composition of leafy vegetables and concentrate diet (control diet)**

| Parameters (%) | *Solanum melongena* | *Abelmoschus esculentus* | *Vigna unguiculata* | *Corchorus olitorius* | *Ipomoea batatas* | Control diet |
|---|---|---|---|---|---|---|
| Dry matter | 26.73 | 23.38 | 24.23 | 26.09 | 24.21 | 79.85 |
| Crude protein | 14.04 | 12.31 | 17.20 | 16.84 | 15.32 | 14.75 |
| Ether extract | 5.29 | 4.82 | 5.00 | 4.64 | 5.46 | 3.70 |
| Crude fiber | 13.41 | 14.29 | 15.46 | 12.62 | 17.35 | 12.56 |
| Ash | 11.40 | 9.18 | 9.38 | 9.56 | 11.22 | 9.6 |

Source: [8-9-10] for leafy vegetables [11] for control diet.

Each diet has been distributed to five rabbits housed individually.During this period the animals also received prophylactic treatment with antibiotics to prevent coccidiosis. Then Cocciliumforte® (Amprolium hydrochloride 20% and 0.2% vitamin K3) was used in the drinking water at a dose of 1g/L for three days [14]. After the acclimatized period, the rabbits were fed to satiety with different diets twice daily (9 am and 17 pm) until the age of 98 days [15]. Water was provided *ad libitum* and renewed each morning.

**Table 2**

**Experiment treatments**

| Treatments | Leafy vegetables and pelleted diet (%) | | | | | |
|---|---|---|---|---|---|---|
| | *Solanum melongena* | *Corchorus olitorius* | *Vigna unguiculata* | *Ipomoea batatas* | *Abelmoschus esculentus* | Control diet |
| A | 16.66 | | 16.66 | | 16.66 | 50 |
| B | | 16.66 | | 16.66 | 16.66 | 50 |
| C | 16.66 | 16.66 | 16.66 | | | 50 |
| D | 16.66 | 16.66 | | 16.66 | | 50 |
| E | | | 16.66 | 16.66 | 16.66 | 50 |
| F | 16.66 | 16.66 | | | 16.66 | 50 |
| G | | 16.66 | 16.66 | 16.66 | | 50 |
| H | 16.66 | | 16.66 | 16.66 | | 50 |
| I | | 16.66 | 16.66 | | 16.66 | 50 |
| J | 16.66 | | | 16.66 | 16.66 | 50 |
| Control | | | | | | 100 |

### *Growth performances*

Weekly live weights (g) of the rabbits were determined by weighing the animals individually using an electronic scale (OHAUS Adventurer Pro Av 3102.). This was done early in the morning prior to feeding. Daily feed intake (DFI) was determined by weighing the left over feed from the quantity of feed filled the previous day.

Data on daily feed intake (DFI)), feed conversion ratio (FCR) and daily weight gain (DWG) were also computed.

Daily Feed intake (FI) was taken as the difference between the feed supplied and left over for each replicate per day. The rabbits were weighed on weekly basis and weight gain for each animal per week was calculated as the difference between the present weight and the weight for the previous week. The daily weight gain

(DWG) was obtained by dividing the total weight gain by the number of days. Feed conversion ratio (FCR) was determined by dividing the quantity of feed consumed by the weight gained.

### *Digestibility determination*

The hard faeces from each cage were collected every morning before food distribution from 56$^{th}$ to 60$^{th}$ day of age [13]. Faeces were weighed then packaged in labeled plastic bags and stored at -20 ° C prior laboratory analysis. For digestibility tests, all of the excreta (faeces) of each batch was first defrosted and then dried in an oven for 24 h at 80° C. Half of each batch of faeces parboiled (80° C) was dried for 24 h at 103° C to determine the dry matter content [13]. The determination of the dry matter content was based on the [16] AOAC (1990) method. The total protein was carried out on the sample stored at 80° C [13].

### *Blood parameters*

At 88$^{th}$ day of age, blood samples were collected from three (3) rabbits per batch selected randomly. Two samples of three (3) mL of blood from each rabbit fasted 10 hours were taken in sterile flasks (4 mL Vacutainer tubes; BD-Plymouth®) early morning (6:00), from the central artery of the ear with a sterile disposable syringe of 5 mL [17].

Blood samples for hematological analysis were collected in flasks containing ethylene diamine tetraacetic acid (EDTA) and were delivered to the laboratory within 2 h of collection and promptly assayed. Hematological analysis was based on MINDRAY® BC-3200 technology [18].

The samples for biochemical analysis were centrifuged (500 rpm, 3 mm) and separated also within 2 h of collection. The resulting blood serum was stored at 4°C until assayed. Biochemical parameters were determined by using a spectrophotometer (BIOLYZER® 100) at a wavelength of 500 nm.

### *Data analysis*

Data were subjected to analysis of variance (ANOVA) using SPSS17 software. Treatment means were compared by one-way analysis of variance followed by Duncan's test.

## 3. Results and discussion

### *Growth performances*

Figure 1 shows the live weight of the rabbits fed with different treatments after 9 weeks of feeding.

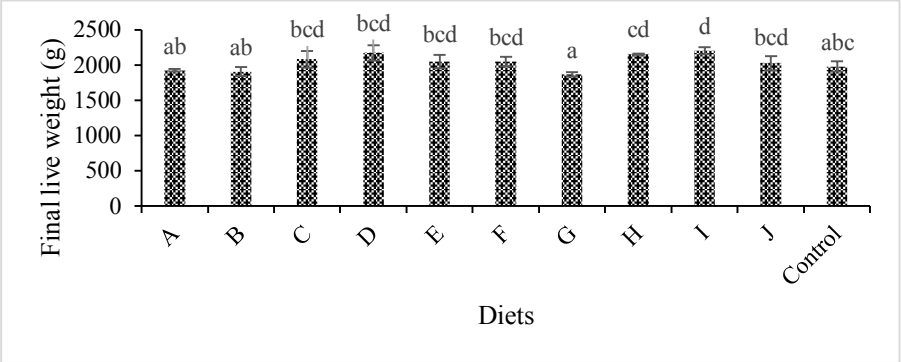


**Figure 1: Variation of rabbit weight during 9 weeks feeding**

The live weight of rabbits was significantly different (P>0.05). The rabbits fed with combination of *Corchorus olitorius, Vigna unguiculata* and *Abelmoschus esculentus* (diet I) had slightly higher live weight than other treatments. While the rabbits fed with *Corchorus olitorius, Vigna unguiculata* and *Ipomea batatas*, recorded low growth with no difference compared to those of rabbit fed with diets A, B and control diet (P<0.05). These results could be attributed to high protein content of *Vigna unguiculata* (17.20%) and *Corchorus olitorius* (16.84%) compared to others leafy vegetables (12-14%).

Table 3 presented the different responses of daily weight gain, daily feed intake and feed conversion ratio of the rabbits fed with different treatments. The daily weight gain ranged from 24.42 to 29.60 g/day and didn't show differences (P < 0.05) between treatments. These values were similar to the findings of [5] who fed rabbits with concentrate supplemented with combination of two green forages. However; the values of daily weight gain recorded in this sturdy were higher than those reported on forage-concentrate diets under most tropical conditions ranging between 5-20 g/day [19]. The feed intake (162.10-188.97g/day) and the feed conversion ratio (6.91-8.21) of rabbit fed with forage were similar (P< 0.05) but were significantly different to the control group (61.55 g/day and 2.69 respectively). This fact would suggested that the forage added in the rabbit's feed would increased their appetite but also the feed intake to satisfy their feed requirements as reported by [4]. The increased feed intake of the rabbits for diets containing forage is understandable since forage contains high fiber, which tended to increase the total fiber content of the diet and diluted other nutrients. The present results showed that adding of forage in rabbit rations significantly (*p<0.05*) increased feed conversion ratio in comparison with control. High feed conversion ratio (6.91-8.21) of different rabbit batches fed with a combination of leaves and pelleted diet was the direct consequence of this high feed intake. Furthermore, it should be noted that the diets with leafy vegetables had higher apparent coefficient of digestibility of dry matter compared to control diet. Values reported about feed digestibility are in good agreement with those reported by [5].

The number of dead rabbit ranged from 1 to 2 rabbits (Table 3). This could be attributed to the supplementation effect of leafy vegetables following the adaptation period.

**Table 3**

**Effect of forages feeding on weaned rabbit's performance**

| Parame-ters (%) | Diets | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | Con-trol |
| DWG (g/day) | 25.46± 7.15a | 24.42± 1.79a | 28.3± 2.97 a | 28.88± 4.76a | 25.16± 2.21a | 25.66± 7.44a | 25.61± 2.40a | 28.45± 2.72a | 29.60± 5.09a | 25.11± 5.56a | 26.52± 0.62a |
| DFI (g/day) | 173.60 ±29.49 b | 162.10 ±26.45 b | 173.8 5±30. 0b | 188.97± 43.47b | 172.32 ±28.80 b | 168.59 ±30.50 b | 173.46± 30.89 b | 172.83 ±31.43 b | 172.00± 32.59 b | 174.21 ±32.83 b | 61.55± 17.31a |
| FCR | 7.97± 0.49 b | 7.91± 0.75 b | 7.02± 0.51 b | 7.71± 0.22b | 7.52± 0.64 b | 7.52± 0.55 b | 8.21± 0.46 b | 7.48± 0.83 b | 6.91± 0.37 b | 7.44± 0.70 b | 2.69± 0.38a |
| Dead rabbit | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

DFI: Daily feed intake, FCR: feed conversion ratio. Values are expressed as a mean value ± standard deviation (n = 5). Means in the same row having different superscripts are significantly different (P < 0.05), while values in the same row with same superscript are not significantly different (P > 0.05).

### *Dry matter and protein digestibility*

Dry matter and protein digestibility ranged from 70.52 to 86.21 % and 86.28 to 91.30 % respectively (Figure 2). These parameters were significantly different ($P< 0.05$). The dry matter digestibility of rabbits fed with diets contained combination of leafy vegetables was higher than those obtained in rabbits fed with the control diet. Protein digestibility of rabbits fed with different diets tests do not differ except diet G (lowest $ACD_P$) and I (highest $ACD_P$) ($p > 0.05$) (Table 5). These results indicated that the forage as leafy vegetables had a positive effect on the nutrients digestibility but facilitated their assimilation.


$ACD_{DM}$: Apparent Coefficient of Dry Matter Digestibility, $ACD_P$: Apparent Coefficient of Protein Digestibility. Values are expressed as a mean value ± standard deviation (n = 5). Means in the same row having different superscripts are significantly different ($P < 0.05$), while values in the same row with same superscript are not significantly different ($P > 0.05$).

**Figure 2. Apparent coefficient of digestibility of grower rabbits fed concentrate and mixture of leafy vegetables combinations**.

### *Blood parameters*

Blood biochemical parameters were presented in table 4. Urea (0.27 - 0.32 g/L), creatinine t (10.15 - 12.47 g/L), glycaemia (0.74-0.82g/L) triglycerides (0.56-1.16 g/L) and HDL (0.49-0.57 g/L) contents did not differ between treatments ($P > 0.05$). The cholesterol total and LDL contents were high for rabbits fed with diet F and low for diet I respectively ($P > 0.05$). These results were in agreement with those observed by [5]. Blood is a good indicator to determine the health of an organism. The values recorded in the present study were similar to the values reported by [20]. The identical creatinine values indicated the normal muscle metabolism as reported by [21]. It also suggested that there was no wasting or catabolism of muscle tissues as observed by [22]. The similarity of urea values is in agreement with the findings of [23] for rabbits fed with concentrate diet supplemented with *Leucaena leucocephala* or *Macroptilium atropurpureum* leaves. The urea values in this study indicated the good liver health. Cholesterol is of animal origin and should come from some animal products used for pellets formulation. Some leafy vegetables combinations especially diet I (mixture of *Corchorus olitorius, Vigna unguiculata* and *Abelmoschus esculentus*) could contribute to reduce total cholesterol value in blood compared with the control group.

Blood also acted as pathological reflector of the whole body; hence haematological parameters are important in diagnosing the functional status of exposed animal to toxicants.

**Table 4.**

**Blood biochemical parameters of rabbit groups fed with different diets.**

| Parameters | Diets | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | Control |
| Urea (g/L) | 0.30 ±0.01 a | 0.25 ±0.05 a | 0.28 ±0.07 a | 0.27 ±0.04 a | 0.27 ±0.01 a | 0.25 ±0.04 a | 0.27 ±0.01 a | 0.32 ±0.01 a | 0.26 ±0.05 a | 0.25 ±0.04a | 0.27 ±0.04 a |
| Glycaemia (g/L) | 0.82 ±0.02 a | 0.77 ±0.06 a | 0.77 ±0.03 a | 0.74 ±0.05 a | 0.74 ±0.04 a | 0.79 ±0.01 a | 0.74 ±0.01 a | 0.79 ±0.01 a | 0.77 ±0.01 a | 0.77 ±0.11 a | 0.75 ±0.06 a |
| Creatinine (mg/L) | 12.11 ±0.59a | 10.19 ±1.12 a | 11.50 ±2.30 a | 11.58 ±2.06 a | 12.47 ±0.54 a | 10.60 ±1.06 a | 10.74 ±0.31 a | 12.83 ±0.25 a | 10.37 ±2.49 a | 10.15 ±1.39 a | 10.94 ±1.68a |
| Total cholesterol (g/L) | 1.70± 0.26 ab | 1.89± 0.07 ab | 1.76± 0.06 ab | 1.66± 0.10 ab | 1.56± 0.00 ab | 1.80± 0.37 b | 1.48± 0.18 ab | 1.74± 0.16 ab | 1.63± 0.06 a | 1.73± 0.08 ab | 1.67± 0.05 ab |
| HDL (g/L) | 0.55± 0.04 a | 0.51± 0.11 a | 0.57± 0.06 a | 0.51± 0.07 a | 0.49± 0.01 a | 0.52± 0.11 a | 0.57± 0.02 a | 0.53± 0.11 a | 0.56± 0.08 a | 0.54± 0.02 a | 0.53± 0.05 a |
| LDL (g/L) | 0.97± 0.16 ab | 0.88± 0.11 ab | 0.98± 0.12 ab | 1.07± 0.36 ab | 1.04± 0.21 ab | 1.15± 0.06 b | 1.06± 0.06 ab | 0.96± 0.00 ab | 0.75± 0.10 a | 1.04± 0.17 ab | 0.92± 0.03 ab |
| Triglycerides (g/L) | 0.88± 0.31 a | 1.16± 0.11 a | 0.74± 0.25 a | 0.86± 0.27 a | 0.56± 0.04 a | 1.05± 0.52 a | 0.79± 0.48 a | 0.85± 0.28 a | 0.95± 0.42 a | 0.68± 0.04 a | 1.11± 0.13 a |

DL: High Density Lipoprotein; LDL: Low Density Lipoprotein. Values are expressed as a mean value ± standard deviation (n = 5). Means in the same row having different superscripts are significantly different ($P < 0.05$), while values in the same row with same superscript are not significantly different ($P > 0.05$).

Hematological values were found to be significantly similar ($P>0.05$) in all parameters measured except MCHC which was high in diet A and low in diet B ($P<0.05$) (Table 5).

## Table 5: Hematological values in rabbit's blood

| Parameters | Diets | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | Control |
| Erythrocytes ($10^6$/mm$^3$) | 5.91± 0.30a | 5.62± 0.26a | 6.34± 0.09a | 5.35± 0.61a | 5.68± 0.34a | 6.32± 0.03a | 6.23± 0.76a | 5.46± 0.35a | 6.19± 0.49a | 5.62± 0.62a | 5.71± 0.01a |
| Leukocytes ($10^3$/mm$^3$) | 4.8± 0.85a | 3.65± 0.64a | 4.8± 1.27a | 3.9± 2.69a | 4.3± 1.56a | 7± 2.55a | 4.15± 0.21a | 6.5± 1.56a | 5.8± 0.57a | 4± 1.41a | 5.5± 0.85a |
| Hemoglobin (g/dl) | 12.7±0. 28a | 12.45± 0.07a | 13.95± 0.07a | 12.25± 1.06a | 12.55± 0.21a | 13.25± 0.35a | 13.2± 0.85a | 12.15± 0.21a | 13.15± 1.34a | 12.2±1. 41a | 12.25± 0.21a |
| MCV (µm$^3$) | 67.55± 6.01a | 73.8± 3.39a | 70.8± 2.83a | 72.3± 0.99a | 72.95± 4.60a | 67± 0.14a | 69± 2.40a | 71.2± 2.62a | 68.6± 0.14a | 69.75± 0.07a | 71.15± 1.77a |
| MCHC (%) | 31.85± 0.49b | 30± 0.14a | 31.05± 0.64ab | 31.45± 0.92ab | 30.35± 0.64ab | 31± 0.71ab | 30.8± 0.71ab | 31.2± 0.28ab | 30.95± 0.64ab | 31.1±0. 14 ab | 30.25± 1.20 ab |
| MCH (pg) | 22.05± 0.78a | 22.1± 0.85a | 21.9± 0.42a | 22.25± 0.21a | 22.05± 0.92a | 20.8± 0.42a | 21.2± 1.27a | 22.2± 0.99a | 21.15± 0.49a | 21.65± 0.07a | 21.4± 0.42a |
| Platelets ($10^3$/ mm$^3$) | 348.5± 41.72a | 324.5± 106.77a | 393± 38.18a | 221.5± 217.08a | 356± 151.32a | 414± 21.21a | 365.5± 48.79a | 329± 142.84a | 392.5± 102.53a | 309± 94.75a | 354± 101.82a |

MCV: mean corpuscular volume; MCHC: mean corpuscular haemoglobin concentration; MCH: mean corpuscular haemoglobin. Values are expressed as a mean value ± standard deviation (n = 5). Means in the same row having different superscripts are significantly different ($P < 0.05$), while values in the same row with same superscript are not significantly different ($P > 0.05$).

This slight disparity in MCHC results could probably be the result of the well-known variability of haematological indicators in rabbits with regard to breed-related and individual differences [18]. MCV, MCH HB, MCHC and platelets were reported to be normal [24]. These results indicated that the blood values of rabbits were not negatively affected by the ingestion of *Vigna unguiculata, Abelmoschus esculentus, Ipomoea batatas, Solanum melongena* and *Corchorus olitorius*. These results suggested that the erytrogenesis was not altered. It indicated efficient oxygen transport and normal haematopoiesis [25]. The results were in agreement with findings of [26] and [27].

## 4. Conclusion

This study showed that rabbits' optimal growth performance can be achieved when they are fed with concentrated supplemented three leaf-vegetables. The forages combination did not have deleterious effects on blood biochemical and haematological parameters. The combination of *Abelmoschus esculentus*, *Vigna unguiculata* and *Corchorus olitorius* leafy vegetables could be recommended as forage which could better support rabbit production. Although, it could reduce the feeding cost, it may need further study on the quality of rabbit meat.

## 5. References

[1]. GHOSH S.K., DAS A, BUJARBARUAH K.M., DAS A., DHIMAN K.R., SINGH M.P. Effect of breed and season on rabbit production under subtropical climate. *World Rabbit Sciences* 16: 29-33, (2008).

[2]. MCCROSKEY. R. Raising rabbit in the Pacific North West Canadian Centre for Rabbit Production Development, Surrey, BC Canada, (2000)

[3]. IYEGHE-ERAKPOTOBOR G. T., ALIYU R. UGURU J. Effect of concentrate and forage type on performance and digestibility of growing rabbits under sub-humid tropical conditions. *African Journal of Biotechnology* 4 (20): 2004-2008, (2006).

[4]. ABONYI F.O., IYI E.O., MACHEBE N.S. Effects of feeding sweet potato (*Ipomoea batatas*) leaves on growth performance and nutrient digestibility of rabbits. (2012)

[5]. YAO K. F., OTCHOUMOU K. A., WOGNIN L. R., NIAMKÉ L. S.. Effect of Combination of Leafy Vegetables on Growth Performances of Rabbit O*ryctolagus cuniculus*. *J. Anim. Sci. Adv.*, 5(12): 1522-1531, (2015)

[6]. N'DRI, M.T., KOUAME, G.M., KONAN, E., TRAORE, D. Plantes alimentaires spontanées de la région du Fromager (Centre-Ouest de la Côte d'Ivoire): flore, habitats et organes consommés. *Sci.Nat.* 1: 61-70. (2008).

[7]. SORO, L.C., OCHO-ANIN, ATCHIBRI, A.L., KOUADIO, K.K.A., KOUAMÉ, C. Evaluation de la composition nutritionnelle des légumes feuilles. *J. Appl. Biosci*. 51: 3567– 3573. (2012).

[8]. ZORO A.F., ZOUÉ L.T., KRA S.A.K., YÉPIÉ A.E., NIAMKÉ S.L.. An Overview of Nutritive Potential of Leafy Vegetables Consumed in Western Côte d'Ivoire. *Pak. J. Nutr.* 12 (10): 949-956. (2013).

[9]. ACHO, C.F., ZOUÉ, L.T., AKPA, E.E., YAPO, V.G., NIAMKÉ, S.L.,. Leafy vegetables consumed in Southern Côte d'Ivoire: a source of high value nutrients. J. *Anim.* Plant *Sci*. 20 (3): 3159-3170. (2014).

[10]. OULAI PATRICIA, LESSOY ZOUÉ, ROSE-MONDE MÉGNANOU, RYTA DOUÉ, SÉBASTIEN NIAMKÉ (2014). Proximate composition and nutritive value of leafy vegetables consumed in northern Côte d'Ivoire. European Scientific Journal February 2014 edition vol.10: 212-227

[11]. MARTIGNON, M.H., COMBES. S., GIDENNE, T. Digestive physiology and hindgut bacterial community of the young rabbit (*Oryctolagus cuniculus*): Effects of age and short-term intake limitation. Comparative Biochemistry and Physiology - Part A. *Mol. Integr. Physiol*., 156: 156-162. (2010).

[12]. KIMSÉ M, SORO D, BLEYERE MN, YAPI J.N., FANTODJI A. (2013). Apport d'un fourrage vert tropical, Centrosema pubescens, en complément au granulé: effet sur les performances de croissance et sanitaire du lapin (*Oryctolagus cuniculus*). *Int J Biol Chem Sci* 7 (3): 1234-1242

[13]. PEREZ JM, LEBAS F, GIDENNE T, MAERTENS L, XICCATO G, PARIGI-BINI R.,

DALLE ZOTTE A, COSSU ME, CARAZZOLO A, VILLAMIDE .J, CARABANO R, FRAGA M, RAMOS MA, CERVERA C, BLAS E, FERNANDEZ J, FALCAO E, CUNHA L, BENGALA FREIRE J. European reference method for in vivo determination of diet digestibility in rabbits. *World Rabbit Sciences* 3: 41-43. (1995).

[14]. KPODÉKON, M., YOUSSAO, A.K.I., KOUTINHOUIN, G.B., BABA, I.L., DESSOU, J.M., DJAGO, Y., Effet de la granulation sur les performances de croissance, l'efficacité alimentaire et la viabilité des lapereaux en condition d'élevage tropical. *Revue Élev. Méd. vét. Pays trop*. 62 (1): 75-80. (2009).

[15]. de Blas C, WISEMAN J. Nutrition of the Rabbit, 2nd Edition, CAB International 2010, p 334. (2010).

[16]. AOAC. Official methods of analysis. Association of Official Analytical Chemists Ed., Washington DC, p 684. (1990).

[17]. COULIBALY FA, COULIBALY A, N'GUESSAN JD, KOUAME KG, DJAMAN AJ, GUÉDÉ-GUINA F. Etude des paramètres sériques biochimiques: le cas des lapins (neozelandais-cunistar) de Côte d'Ivoire. *Sci Nat* 4 (1): 37-43, (2007).

[18]. POLJIČAK-MILAS, N., I. KARDUM-SKELIN, M. VUĐAN, T. S. MARENJAK, A. BALLARIN-PERHARIĆ, Z. MILAS. Blood cell count analyses and erythrocyte morphometry in New Zealand white rabbits. *Vet. arhiv* 79, 561-571. (2009)

[19]. HONGTHONG P, KONGVONGXAY S, TY C, PRESTON TR. Water spinach (*Ipomoea aquatica*) and Stylo 184 (*Stylosanthes guianensis* CIAT 184) as basal diets for growing rabbits. *Livest. Res Rural Develop*, 16 (5). (2004). http://www.cipav.org.co/lrrd/lrrd16/5/hong16034.htm

[20]. VAN PRAAG E. Biochemistry reference values. Medi Rabbit. (2004) Com http://www.medirabbit.com.

[21]. ONIFADE A.A., TEWE O.O. Alternative tropical energy feed resourcesin rabbit diets: growth performance, diet's digestibility and blood composition. *World rabbit science* (1): 17-24, (1993).

[22]. NJIDDA A.A., ISIDAHOMEN C.E. Hematology, blood chemistry and carcass characteristics of growing rabbits fed grasshopper meal as a substitute for fish meal. *Pakistan Vet. J.,* 30(1)2: 7-12. (2010).

[23]. MAKINDE O.J. Growth performance, carcass yield and blood profiles of growing rabbits fed concentrate diet supplemented with white lead tree (*Leucaena leucocephala)* or siratro (*Macroptilium atropurpureum*) leaves in north central Nigeria. Trakia journal of sciences, 14(1): 80-86, (2016).

[24]. MITRUKA B. M., RAWNSLEY H. M. Clinical Biochemical and Haemotological reference value in normal experimental animals. Mason publishing USA Inc. 86-140. (1977).

[25]. BLOOD D.C., HENDERSON J.A., RADOSTISTS O.M. Veterinary medicine. London. 5th ed. BeilliersTindahpublishers pp. 241-249. (1979).

[26]. OJEBIYI O.O., SHITTU M.D., OLADUNJOYE I.O. OMOTOLA O.B, OLANIYI S.A. Haematology, carcass and relative organ weights of growing rabbits on skip-a-day concentrate feeding regime. *International Journal of Applied Agricultural and Apicultural Research* 9 (1&2):167-174, (2013).

[27]. TIMIBITEI K.O., ALIKWE P. N. C., AYAKURAI J. I., OHIMAIN E. I. Haematological characteristics and organ weights of rabbits fed Alchornea Cordifolia Leaf meal. *Intl J Farm Alli Sci* 3 (7): 754-759. (2014).