BloEx - Journal
Britain International of
EXACT Sciences Journal
Publish: | January - May - September |
E-ISSN: 2686-1208
P-ISSN: 2686-1216
http://biarjournal.com/index.php/bioex

Effect of Supplemented Food with Wild Mango (Irvingia Smithii) Almond Powder on the Weight Growth of Mice

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Abstract:

Almond powder of Irvingia smithii has been incorporated, at the doses of 25 and 50 %, in mice standard ration (prepared by Matadi mill), at INRB, composed of wheat flour, wheat bran and pellets for rabbits to evaluate weight gain, live weight gain and feed conversion and to assess motor activity after 50 days of feeding. Results showed an average increase in live weight gain of 31.08% and 8.36% for the groups of mice fed food supplemented with Irvingia smithii almond powder respectively at 25% and 50% higher than the group of control mice fed exclusively with the standard food. On the other hand, the food consumption index (F.C.I) was very low for the group of mice fed with the food supplemented at 50% (F.C.I. 27.73) and low for the group of mice fed 25% supplemented food (F.C.I. 64.83) compared to the control group (F.I.C. 108,14). In addition, the groups of mice fed the supplemented food did not show motor weakness, even fewer respiratory complications or health problems compared to the control during these 50 days of observation. Live weight gain sufficiently demonstrates the nutritional value of the kernel of I. smithii.

Keywords:
Irvingia smithii; almonds powder; mice; weight gain; feed conversion

I. Introduction

Irvingia smithii, a wild mango spécies, is a non-timber forest product (NWFP) with multiple uses for the people of central and western Africa (Awono and al., 2009; Eyog Matig and al., 2006). It is a tree belonging to the Irvingiaceae family and its area of distribution extends from southern Senegal, through southern Sudan, to Angola (Tobe and al., 2001).

It grows wild in the humid forest areas of tropical Africa (Anonyme 1, 2008; Tailfer, 1989), bearing edible fruits containing the kernels which are used as an ingredient and/or foodstuff to season dishes, color and thicken sauces like the kernel of Irvingia gabonensis and Irvingia wombolu, like peanuts and squash, or eaten as peanuts in Congo Brazzaville (Anonyme 5, 2015; Gindo and al., 2015; Loumouamou and al., 2013; Silou and al., 2004). It adds a characteristic flavor and a slightly sticky texture to the sauce.

Like other foodstuffs of plant origin, almonds of Irvingia smithii could contain certain antinutritional factors and varied components susceptible to lead to the harmful consequences for their consumers (FAO, 2002; Gindo and al., 2015).

In addition, nutritional diseases can be due either to an overall very insufficient food intake (marasmus, kwashiorkor, vitamin deficiency, rickets, blindness, anemia, scurvy,

xerophthalmia, goitre, etc.), either to an excessive intake of food, particularly fats and carbohydrates (obesity, cardiovascular diseases). It can also due to an abnormal use by the body of certain nutritional components of food (metabolic diseases), and to the presence of toxic products (antinutritional factors) in food (food poisoning) (Cheftel and al., 1984; Conne, 1979; Tome, 1995). Their studies are usually done on rats and mice (Katya-Katya, 1985).

II. Material and Methods

2.1 Material

a. Experimental Feed

Almonds were from Irvingia smithii fruits harvested in the Botanical Garden of Kisantu in the Kongo-central Province, DRC, on June 14, 2015. These fruits were sun dried during two weeks before to be crushed to recover the almonds, which were sun dried first, then redried in an oven brand MEMMERT model 100-800 at 50°C for 24 hours before being crushed using a Moulinex brand PHILIPPS HR2027. The powder obtained constituted the experimental ingredient.

Chemical analysis of different formulated feeds was carried out in the laboratory of the Congolese Control Office (OCC) of Kinshasa, DR Congo.

Figure 1. *Fresh fruits of I. smithii*

Figure 2. *Dried almonds of I. smithii*

b. Standard Feed

The usual mice feed provided by the National Institute for Biomedical Research (INRB) consists of wheat flour, wheat bran and pellets for rabbits (see photo 6 in appendix 6); all these ingredients coming from the Minoterie de Matadi/Kinshasa-RDC (MIDEMA).

c. Experimental Animal

Mice of NMRI strain provided by the National Institute of Biomedical Research (I.N.R.B.) of Kinshasa, DRC, were used as experimental animals. This strain results from a selection of pure breeds not carrying any metabolic defect and selected by Donaldson at the beginning of the twentieth century at the Wistar Institute (U.S.A). This is a versatile strain, as it lends itself to long-term studies in all biomedical disciplines (KATYA-KATYA, 1985); being omnivorous, it supports various diets.

Given the unavailability of animals of the same weight, 15 male mice aged 3 months were used so that the average weight (18.203g ± 0.9142) of different animals did not show significant differences between them.

III. Research Methods

3.1 Feed Formulation

Three types of food have been established, namely :

- **T_0** = (Control) : 30 g of standard food (wheat flour, wheat bran and pellets for rabbits) cooked in the oven at 120°C for one hour ;
- **T_1 = (T_0+25%)** : 30 g of the mixture made up of 22.5 g of standard food and 7.5 g of *Irvingia smithii* almond powder (experimental feed) cooked in the oven at 120°C for one hour ;
- **T_2 = (T_0+50%)** : 30 g of the mixture made up of 15 g of standard feed and 15 g of *Irvingia smithii* almond powder (experimental food) cooked in the oven at 120°C for one hour.

3.2 Experimental Design and Conduct of the Supplementation of the Ration of Mice Using Almond Powder of Irvingia Smithii

Three groups of mice were formed to constitute the three treatments :

- ✓ 1st group for **T_0** : 5 male mice serving as controls, fed exclusively with the standard feed ;
- ✓ 2nd group for **T_1** : 5 male mice fed standard feed supplemented with 7.5 g of *Irvingia smithii* kernels (25%);
- ✓ 3rd group for **T_2** : 5 male mice fed standard food supplemented with 15 g of *Irvingia smithii* almond (50%).

Each group of five mice was placed in plastic rearing cages with a steel mesh serving as a lid and at the bottom of which were placed wood shavings as an absorber of urine, faeces and dust. A plastic bottle serving as a drinker was attached to part of the lid (Figure 3).

Feed was regularly distributed each morning after having weighed the amount of feed not consumed the previous day.

Figue 3. *Experimental Setup Showing Mice in Rearing Cages*

Following characteristics were regularly determined :

- ✓ Weight growth : daily determined by weighing mice at the beginning of each day;
- ✓ Live weight gain (GW): determined by the difference between the initial (P1) and final (P2) weights of the mice divided by the initial weights (P1) and multiplied by 100 :

% GW = $\frac{Pf - Pi}{P_i} x100$ where : P_i = initial average weight and P_f = final average weight

- ✓ The consumption index IC : determined by the ratio between the quantity consumed (Qc) and the live weight gain (%GW)

  $IC = \frac{QC}{GP}$; where Q_C : Quantity consumed (g) is the difference of the daily weights of the mice ration (every morning): $Q_c = Q_i - Q_f$ with Q_i is the quantity of feed weighed before being consumed and Q_f is the quantity of weighed food not consumed the following day to determine the quantity Q actually consumed;
- ✓ Motricity: assessed by observing mobility, possible metabolic disorders, manifestation of abnormalities, weakness and negative signs compared to controls fed exclusively on standard food.

Food was provided during 50 days. Experiment was carried out in the animal room of the National Institute for Biomedical Research (INRB) in Kinshasa/DRC at room temperature from December 17, 2015 to February 3, 2016.

3.3 Feed Bromatological Analysis

Water content was determined by the conventional method of drying in an oven at 105°C until a constant mass of dry matter was obtained and that of the raw ash by calcination in a muffle furnace at 550°C (AFNOR, 1981 ; VERVACK, 1982). Crude proteins were determined by the Kjeldalh method, while lipid content was determined by the Soxhlet method using petroleum ether (AFNOR, 1981). The fibers were assayed according to the method of Kurschner (VERVACK, 1982). Total carbohydrate content was determined by 100% difference with other food components (moisture % + protein % + fat % + crude fiber % + ash %) (AFNOR, 1981). Energy was calculated using the method described by Mbemba and Remacle (1992) and by applying the ATWATER coefficients for proteins, lipids and carbohydrates (AFNOR, 1981).

3.4 Statistical Analysis

Means and standard deviations were used to describe the data; while the statistical analysis referred to the analysis of variance using STATISTIX software version 10.0.

The Student's T test, tests of multiple comparison, of LSD, Tukey, Scheffé and Bonferroni at the 5% threshold allowed to examine the differences observed between the means of the groups (difference between the treatments), and that of the comparison of the coefficients of variation (CV) at the 20% cutoff to examine differences between means of mice within groups (difference within treatments).

IV. Discussion

4.1 Bromatological Composition of Mice Feed Formulations

Table 1 presents the bromatological composition of the different feed formulations for the mice.

Table 1. Chemical Composition Mice Feed Formulations

Parameters	T0	T1	T2
Moisture (g/100g)	58 ± 1	55 ±1	47 ± 2
Crude protein (g/100g)	6,21 ± 0,6	8,26 ± 0,1	10,82 ± 0,14
Fat (g/100g)	0,52 ± 0,04	4,46 ± 0,4	11,74 ± 0,3
Total ash (g/100g)	1,39 ± 0,22	1,97 ± 0,05	3,23 ± 0,7
Carbohydrate (g/100g)	31 ± 1	23,6 ± 0,5	19 ± 3
Crude fibers (g/100g)	3,27 ± 0,1	6,76 ± 0,4	8,08 ± 0,7

Energy (kcal)	155 ± 5	171 ± 4	228 ± 14
Ca^{2+} (g/100g)	0,63 ± 0,05	1,16 ± 0,1	2,49 ± 0,24
Mg^{2+} (g/100g)	0,06 ± 0,02	0,41 ± 0,2	0,26 ± 0,1

Legend :
T0 = Formulation of standard feed (Control)
T1 = Standard feed formulation supplemented with 25% *Irvingia smithii* almond powder
T2 = Standard feed formulation supplemented with 50% *Irvingia smithii* almond powder.

It appears from the analysis of variance (see appendix 5) of table 1 that the three feed formulations (T0, T1, T2) are different from each other on bromatological value point of view. The incorporation of ground *I. smithii* almonds enriched the ration in protein, lipids, fibres, ash and energy, but the carbohydrate content decrease while the incorporation was going higher.

4.2 Influence of the Almond of *Irvingia smithii* on the Weight Growth of Mice as a Function of Time

Figure 4 shows the weight growth curves of mice fed and not fed feed enriched with *Irvingia smithii* almond powder as a function of time (see table 2 in appendix 1).

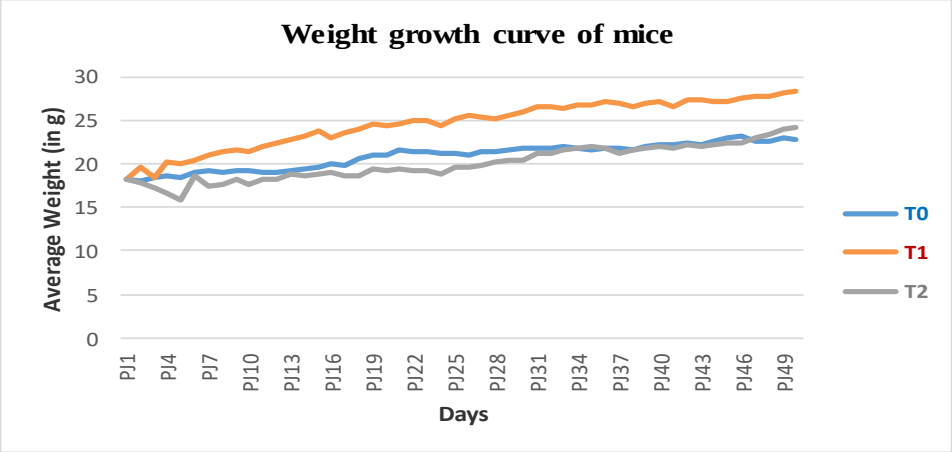

Figure 5. *Weight Growth Curves of Mice*

Legend :
T0 = Group of mice control (exclusively fed standard feed)
T1 = Group of mice fed standard feed supplemented with 25% *Irvingia smithii* almond powder
T2 = Group of mice fed standard food supplemented with 50% Irvingia smithii almond powder

A slow and progressive weight change was observed in all the mice for all the groups (T0, T1, T2) over 50 days of feeding, but to different degrees depending on the formulation of different foods (see Table 2 in Appendix 1). The weights of mice fed and not fed almond powder all increased according to their bromatological composition. However, this increase is clearly greater for the group of mice fed the standard food enriched at 25% and for those fed the standard food supplemented at 50%; the difference in weight before and after feeding being 10.19g and 6.05g respectively. The control group showed a weight difference of 4.56g. It should be noted that beyond the threshold of 25% of incorporation of almond powder of *Irvingia smithii* in the usual ration, growth is weak.

4.3 Comparison of Weight Gains between Mice Fed and not Fed Enriched with Irvingia smithii Almond Powder

Figure 6 shows the live weight gains obtained after feeding mice fed and not fed feed enriched with *Irvingia smithii* almond powder (see table 3 in appendix 2).

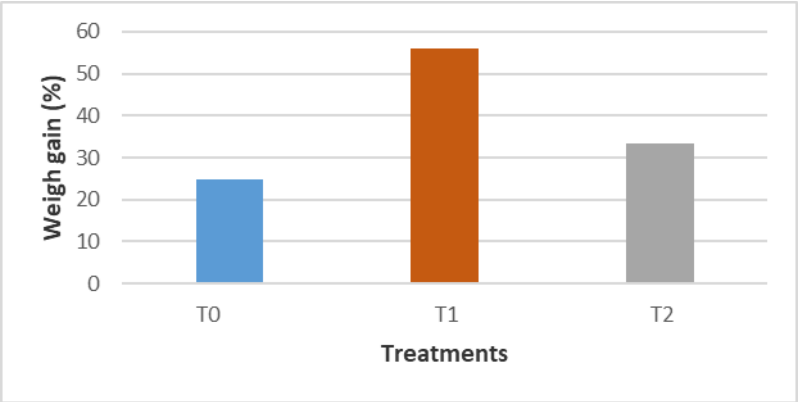

Figure 6. *Comparison of Weight Gain*

Legend :
T0 = Group of mice control (exclusively fed standard feed)
T1 = Group of mice fed standard feed supplemented with 25% *Irvingia smithii* almond powder
T2 = Group of mice fed standard feed supplemented with 50% *Irvingia smithii* almond powder

Figure 6 shows that the mice fed with the feed enriched with the almond powder of *Irvingia smithii* at 25% after 50 days of feeding have a live weight gain of 56.03% higher than the mice controls with 24.95%, with a difference of 31.08%. It is the same but with a low intensity for the mice fed with the feed supplemented at 50% which gave a weight gain of 33.31%, that means a slight difference compared to the control of 8.36% (see table 3 in appendix 2).

The analysis of variance (appendix 4) shows that there is a significant difference between the treatments (T0, T1, T2). The Student's T tests of multiple comparison of LSD, Tukey, Scheffé and Bonferroni at the probability threshold of 5% (see appendix 4) confirmed that the mice fed at 25% (T1) have a gain in live weight clearly high. Treatments T2 and T0 are similar at the 5% probability threshold.

The comparison test of the coefficients of variation at the 5% probability threshold confirmed that the mice of the T0 and T1 groups are homogeneous, showing no significant difference within their groups (intragroup variability) on the other hand those of the group T2 are moderately homogeneous.

The incorporation of almond powder of *Irvingia smithii* at the threshold of 25% brought a positive effect on the growth of the mice and less positive with 50%. This would probably be due to the high levels of certain dietary fibers contained in the rations that were too enriched with almonds (table 1). According to Anonymous 2, 3, 4 (2015), NGONDI and al. (2005 & 2009) and ADAMSON and al. (1986 & 1990), the almond of *Irvingia* spp would be the solution for rapid and substantial weight loss by reducing appetite and consequently obesity, lowering bad cholesterol (LDL) and risk diabetes, the concentration of good cholesterol (HDL) and the strengthening of the immune system thanks to a water-soluble fiber which would be able to slow down the emptying of the stomach by producing a feeling of satiety (appetite suppressant) and by decreasing the absorption of glucose into the blood, which could help control insulin levels and prevent insulin resistance. On the other hand,

soluble fiber binds to bile acids in the intestine and eliminates them with the stool. As a result, the body is forced to produce more bile acids from cholesterol, which has the effect of lowering overall cholesterol levels. Finally, Irvingia almond soluble fiber has the same effects as many other soluble fibers found in many fruits, vegetables and plants.

4.4 Consumption Index of Mice Fed and not Fed Feed Enriched with Irvingia smithii Almond Powder as a Function of Time

Figure 7 shows the variation in the consumption index of mice fed and not fed feed enriched with Irvingia smithii almond powder as a function of time (Table 4 in Appendix 3).

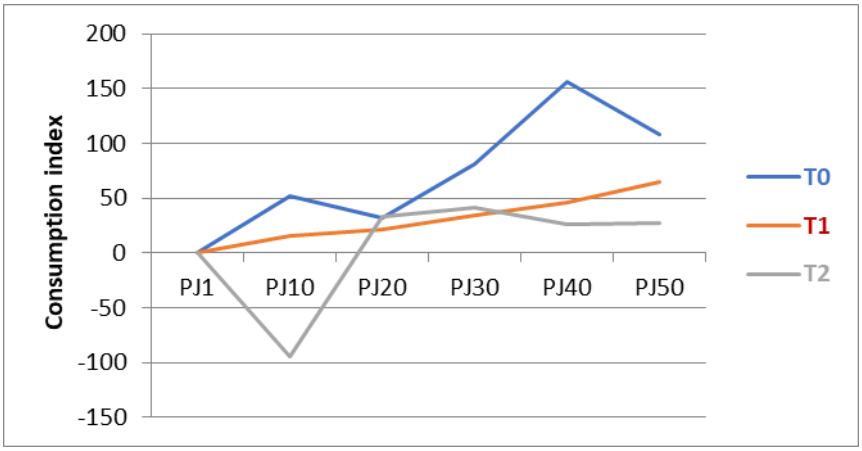

Figure 7. *Variation of the Consumption Index of Mice with the Time*

Legend :
T0 = Group of mice control (exclusively fed standard feed)
T1 = Group of mice fed standard feed supplemented with 25% *Irvingia smithii* almond powder
T2 = Group of mice fed standard feed supplemented with 50% *Irvingia smithii* almond powder.

Figure 7 shows that the feed index undergoes a positive variation for the groups of T0 and T1 mice but negative for the group of T2 mice and to different degrees. This last group will wait more than 10 days of feeding to see their index become positive.

In general, the feed consumption index is very low for the group of mice fed feed supplemented at 50% (IC 27.73) and low for the group of mice supplemented at 25% (IC 64.83) and very high for the group of control mice (IC 108.14). The presence of increasingly high fiber contents in the supplemented formulations (T2 › T1) would be the basis of the decrease in palatability (see point 3.3).

4.5 Mice Motricity

In addition to the increase in weight, all the mice behaved normally well and in the same way: they remained mobile and did not show any weakness, even fewer respiratory complications or health problems (metabolic disorders).

It should rather be noted a slight decrease in palatability for the group of mice fed food supplemented at 50% (T2). This decrease in palatability is weakly observed for the group of mice fed with food supplemented at 25% (T1).

Like other foodstuffs of plant origin containing antinutritional factors such as soya, yam, tomato, sorrel, etc., foodstuffs regularly consumed, it has not yet been detected following consumption of *Irvingia* almonds had any adverse or suspected adverse health effects, nor found any toxic substances in human tissues or urine (Anonyme 6, 2015).

Soluble fiber from wild mango kernel (*Irvingia*) like other forms of water-soluble dietary fiber, is used to reduce abdominal fat as a new source of central anti-obesity ingredient and also used to help diabetics. Considering the wide use of *Irvingia* almonds in the preparation of various dishes in Cameroon, Nigeria, Gabon, Congo, its use should be encouraged for purposes of dietary lipid control as well as weight reduction (NGONDI and al., 2005 & 2009; ADAMSON and al., 1986 & 1990).

In perspective for the future, we suggest that studies be oriented towards the determination of the rate of soluble and insoluble dietary fibers of *Irvingia* almonds and to follow the evolution of the levels of lipids and blood sugars according to the consumption of increasing doses almonds added to the basic food ration. It will also be a question of extending the duration of the experiment to at least six months in order to observe whether or not there is any emergence of cardiovascular diseases and hyperglycemia (diabetes).

V. Conclusion

The test on the incorporation of various doses of almond powder from *Irvingia smithii* in the usual ration of mice fed for 50 days led to the conclusion that the mice fed the food supplemented with 25% and 50% with the almond powder of *Irvingia smithii* had an average gain in live weight respectively of 56.03% and 33.31% higher than the controls with 24.95%, a difference of 31.08% and 8.36% compared to control mice.

This difference in live weight gains demonstrates the nutritional value of *Irvingia smithii* ground almonds. However, the food consumption index is very low for the group of mice supplemented with 50% T2 (IC 27.73) and low for the group of T1 supplemented with 25% (IC 64.83) and very high for the group of T0 control mice (IC 108.14). In addition, the mice did not show any weakness or metabolic disorders due to the consumption of food supplemented with almond powder, even fewer respiratory complications or health problems compared to the controls. However, a slight decrease in appetite was noted for the group of mice fed with 50% supplemented food (T2), and this decrease in appetite is very weakly observed for the group of mice fed with supplemented food. at 25% (T1).

Remerciement

We thank the Coordinator and the whole team of the Academy of Research and Higher Education/Belgium ARES-UNIKIN 2015 for their punctual support in the financing of laboratory analysis and the laboratory technician Guy MUDINGI of the Animal Service of the National Institute of Biomedical Research (INRB) of Kinshasa/DRC for carrying out this experiment.

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ANNEX 1.

Table 2. Weight Change of *Irvingia smithii* Almond-fed and Non-almond-fed Mice as a Function of Time

	T01	T02	T03	T04	T05	∑T0	MOY	SD	T11	T12	T13	T14	T15	∑T1	MOY	SD	T21	T22	T23	T24	T25	∑T2	MOY	SD
PJ1	19,08	19,11	18,22	16,73	18,18	**91,32**	**18,26**	**0,97**	17,03	19,86	17,53	17,62	18,86	**90,9**	**18,18**	**1,16**	17,31	18,67	17,57	19,27	18,01	**90,83**	18,17	0,8
PJ2	18,27	19,67	18,47	17,26	16,52	**90,19**	**18,04**	**1,21**	19,43	17,86	20,08	19,77	21,08	**98,22**	**19,64**	**1,17**	16,97	17,44	17,18	18,53	19,23	**89,35**	17,87	0,97
PJ3	18,49	19,53	19,18	16,63	18,35	**92,18**	**18,44**	**1,12**	18,45	17,05	18,74	18,56	19,04	**91,84**	**18,37**	**0,77**	16,04	16,5	16,4	18,3	19,09	**86,33**	17,27	1,34
PJ4	19,71	19,81	18,99	17,04	17,62	**93,17**	**18,63**	**1,25**	20,21	19	20,41	20,18	20,79	**100,6**	**20,12**	**0,67**	15,38	15,87	15,63	17,2	18,64	**82,72**	16,54	1,37
PJ5	18,8	19,75	18,52	16,45	18,92	**92,44**	**18,49**	**1,23**	19,98	19,51	20,63	19,75	20,47	**100,3**	**20,07**	**0,47**	15,36	14,63	15,24	15,85	18,02	**79,1**	15,82	1,3
PJ6	18,83	20,22	19,17	17,3	19,11	**94,63**	**18,93**	**1,05**	20,7	19,22	20,1	20,77	21,42	**102,2**	**20,44**	**0,83**	18,41	17,53	18,55	18,48	20,15	**93,12**	18,62	0,95
PJ7	19,01	20,27	19,81	17,59	19,73	**96,41**	**19,28**	**1,05**	21,59	19,63	21,04	20,99	22,17	**105,4**	**21,08**	**0,94**	17,19	15,67	17,03	17,47	20,03	**87,39**	17,48	1,59
PJ8	17,16	20,19	19,83	17,25	20,24	**94,67**	**18,93**	**1,59**	21,6	20,17	21,16	21,65	22,46	**107**	**21,41**	**0,84**	17,41	15,96	17,16	17,46	20,5	**88,49**	17,7	1,68
PJ9	16,41	21,4	20,01	17,93	19,97	**95,72**	**19,14**	**1,97**	22,06	20,39	21,49	21,45	22,58	**108**	**21,59**	**0,82**	18,19	16,71	17,98	17,81	20,36	**91,05**	18,21	1,33
PJ10	15,89	21,25	20,37	18,2	20,54	**96,25**	**19,25**	**2,2**	22,28	20,37	21,24	21,27	22,09	**107,3**	**21,45**	**0,77**	17,32	16,36	17,37	17,18	19,95	**88,18**	17,64	1,36
PJ11	15,3	20,91	20,04	18,22	20,22	**94,69**	**18,94**	**2,26**	22,67	21,37	21,85	21,13	22,86	**109,9**	**21,98**	**0,77**	18,12	16,34	18,09	17,63	20,43	**90,61**	18,12	1,48
PJ12	15,12	21,13	20,41	18,16	20,08	**94,9**	**18,98**	**2,42**	23,02	21,61	21,88	21,98	23,11	**111,6**	**22,32**	**0,69**	18,34	16,86	18,21	17,46	20,52	**91,39**	18,28	1,39
PJ13	16,23	20,96	20,39	17,96	20,18	**95,72**	**19,14**	**1,99**	23,42	22,16	22,44	22,68	23,64	**114,3**	**22,87**	**0,64**	19,04	17,3	18,77	17,88	20,63	**93,62**	18,72	1,27
PJ14	16,78	21,03	20,49	18,37	20,35	**97,02**	**19,4**	**1,78**	23,73	22,47	22,79	22,71	24,08	**115,8**	**23,16**	**0,7**	18,99	16,84	18,93	17,45	20,87	**93,08**	18,62	1,57
PJ15	17,49	21,17	21	18,02	19,97	**97,65**	**19,53**	**1,69**	24,2	22,6	23,33	23,79	24,67	**118,6**	**23,72**	**0,8**	19,03	17,41	18,92	17,54	21,36	**94,26**	18,85	1,59
PJ16	18,21	21,84	21,13	18,62	20,35	**100,2**	**20,03**	**1,57**	23,81	21,8	22,68	22,45	23,63	**114,4**	**22,87**	**0,84**	19,35	17,53	19,36	17,47	21,25	**94,96**	18,99	1,57
PJ17	18,35	21,52	21,35	18,28	19,82	**99,32**	**19,86**	**1,56**	24,2	22,59	23,35	23,2	24,53	**117,9**	**23,57**	**0,78**	19,01	17,15	19,35	16,84	20,6	**92,95**	18,59	1,58
PJ18	18,73	22,35	22,14	19,21	20,26	**102,7**	**20,54**	**1,66**	24,66	22,75	23,73	23,67	24,71	**119,5**	**23,9**	**0,81**	18,93	16,79	19,44	16,95	21,23	**93,34**	18,67	1,85
PJ19	19,45	22,74	21,9	20,21	20,21	**104,5**	**20,9**	**1,36**	25,32	23,37	24,35	24,37	25,17	**122,6**	**24,52**	**0,78**	19,27	17,66	20,55	17,45	21,76	**96,69**	19,34	1,85
PJ20	19,78	23,12	22,33	19,91	20,12	**105,3**	**21,05**	**1,56**	24,93	23,49	23,72	24,24	25,13	**121,5**	**24,3**	**0,72**	18,99	17,32	20,66	17,54	21,39	**95,9**	19,18	1,82
PJ21	19,98	23,65	22,62	20,34	20,86	**107,5**	**21,49**	**1,58**	25,13	23,77	24,95	24,16	25,21	**123,2**	**24,64**	**0,64**	19,17	17,14	21,14	17,67	21,88	**97**	19,4	2,08
PJ22	20,5	23,12	22,56	20,49	20,74	**107,4**	**21,48**	**1,26**	25,07	23,98	25,06	24,79	25,44	**124,3**	**24,87**	**0,55**	18,63	17,1	20,96	17,82	21,73	**96,24**	19,25	2,01
PJ23	20,99	22,74	21,76	20,32	21,04	**106,9**	**21,37**	**0,92**	25,19	23,95	24,74	24,85	25,66	**124,4**	**24,88**	**0,63**	18,71	16,69	21,34	17,55	21,64	**95,93**	19,19	2,22
PJ24	20,85	22,79	21,73	19,75	20,99	**106,1**	**21,22**	**1,13**	24,2	23,45	24,7	24,36	24,8	**121,5**	**24,3**	**0,54**	18,26	15,65	20,75	18,18	20,95	**93,79**	18,76	2,18

PJ25	21,32	22,66	21,85	19,39	20,84	**106,1**	**21,21**	**1,22**	25,21	24,46	25,2	25,16	25,6	**125,6**	**25,13**	**0,41**	18,3	16,49	22,01	18,89	22,08	**97,77**	19,55	2,44
PJ26	21,03	21,9	21,62	18,7	21,48	**104,7**	**20,95**	**1,29**	25,79	25,31	25,62	25,31	25,83	**127,9**	**25,57**	**0,25**	18,22	16,38	22,04	19,33	22,06	**98,03**	19,61	2,47
PJ27	21,1	22,99	22,25	19,01	21,41	**106,8**	**21,35**	**1,5**	25,28	25,03	25,65	25,02	25,66	**126,6**	**25,33**	**0,32**	18,22	16,87	22,13	19,57	22,37	**99,16**	19,83	2,41
PJ28	21,21	22,96	21,95	19,44	21,68	**107,2**	**21,45**	**1,29**	25,19	24,9	25,41	25,36	25,21	**126,1**	**25,21**	**0,2**	18,31	17,36	22,69	20,22	22,83	**101,4**	20,28	2,49
PJ29	21,22	23,05	22,15	19,68	21,91	**108**	**21,6**	**1,26**	25,79	25,2	25,57	25,5	25,87	**127,9**	**25,59**	**0,26**	18,05	17,38	22,81	20,44	23,07	**101,8**	20,35	2,63
PJ30	21,99	23,09	21,76	19,78	22,55	**109,2**	**21,83**	**1,26**	25,92	25,48	26,12	25,72	26,12	**129,4**	**25,87**	**0,27**	18,36	17,57	22,94	20,67	22,8	**102,3**	20,47	2,47
PJ31	21,69	22,43	21,31	19,89	23,33	**108,7**	**21,73**	**1,29**	26,46	26,38	26,91	26,56	26,62	**132,9**	**26,59**	**0,2**	19,76	18,61	23,18	21,32	23,19	**106,1**	21,21	2,04
PJ32	22,02	22,04	21,59	20,47	23,2	**109,3**	**21,86**	**0,98**	26,73	26,4	26,75	26,32	26,23	**132,4**	**26,49**	**0,24**	19,22	18,47	23,25	21,78	23,15	**105,9**	21,17	2,22
PJ33	22,22	22,24	21,81	19,83	23,75	**109,9**	**21,97**	**1,41**	26,53	26,4	26,43	26,29	25,87	**131,5**	**26,3**	**0,26**	19,14	18,73	23,44	22,48	23,83	**107,6**	21,52	2,42
PJ34	22,01	21,89	22,02	19,69	23,57	**109,2**	**21,84**	**1,39**	26,99	26,67	26,82	26,89	26,43	**133,8**	**26,76**	**0,22**	19,56	19,22	24,05	22,85	23,65	**109,3**	21,87	2,3
PJ35	22,24	22,01	21,45	18,88	23,11	**107,7**	**21,54**	**1,6**	27,18	26,86	26,9	26,54	26,45	**133,9**	**26,79**	**0,29**	19,22	19,58	24,06	23,18	23,93	**110**	21,99	2,4
PJ36	22,5	22,16	21,84	19,52	22,93	**109**	**21,79**	**1,33**	27,52	27,33	27,18	26,56	26,62	**135,2**	**27,04**	**0,43**	18,95	19,36	23,84	22,92	23,85	**108,9**	21,78	2,43
PJ37	22,35	22,05	21,8	19,6	22,81	**108,6**	**21,72**	**1,24**	27,2	27,24	26,69	26,51	26,62	**134,3**	**26,85**	**0,34**	18,77	18,47	23,56	22,5	23,02	**106,3**	21,26	2,44
PJ38	22,45	22,32	21,94	19,5	21,96	**108,2**	**21,63**	**1,21**	27,05	26,84	26,57	26,09	26,39	**132,9**	**26,59**	**0,38**	18,74	19,57	23,45	22,37	23,57	**107,7**	21,54	2,25
PJ39	22,79	22,21	22,01	20,05	23,03	**110,1**	**22,02**	**1,18**	27,67	27,06	26,91	26,59	26,88	**135,1**	**27,02**	**0,4**	19,76	19,93	23,53	22,39	23,68	**109,3**	21,86	1,91
PJ40	22,98	22,67	22	20,45	22,92	**111**	**22,2**	**1,05**	28,16	27,38	27,34	26,72	26,31	**135,9**	**27,18**	**0,71**	19,38	19,99	23,99	22,59	24,27	**110,2**	22,04	2,26
PJ41	22,67	22,72	22,12	20,55	22,94	**111**	**22,2**	**0,97**	27,25	26,69	26,83	26,32	25,79	**132,9**	**26,58**	**0,55**	18,77	19,86	23,83	22,29	24	**108,8**	21,75	2,35
PJ42	22,99	22,94	22,32	20,45	23,01	**111,7**	**22,34**	**1,1**	27,76	27,78	27,3	26,78	26,65	**136,3**	**27,25**	**0,53**	19	20,73	23,98	22,97	24,12	**110,8**	22,16	2,23
PJ43	23,56	22,14	21,99	21,05	22,24	**111**	**22,2**	**0,9**	27,99	27,51	27,01	26,93	26,93	**136,4**	**27,27**	**0,47**	19,11	19,75	24,19	22,58	24,24	**109,9**	21,97	2,43
PJ44	23,78	23,12	21,85	21,01	23,28	**113**	**22,61**	**1,14**	27,74	27,72	27	26,74	26,62	**135,8**	**27,16**	**0,53**	19,55	20,06	24,13	23,08	24,25	**111,1**	22,21	2,25
PJ45	23,85	23,78	22,35	21,04	23,49	**114,5**	**22,9**	**1,2**	28,13	27,32	26,47	26,65	27,15	**135,7**	**27,14**	**0,65**	20	20,14	24,21	23,12	24,22	**111,7**	22,34	2,12
PJ46	23,89	23,54	22,45	22,01	23,49	**115,4**	**23,08**	**0,8**	29,01	27,93	26,74	27,3	26,78	**137,8**	**27,55**	**0,95**	20,05	19,94	24,26	23,52	24,6	**112,4**	22,47	2,3
PJ47	23,76	23,35	21,02	21,55	22,78	**112,5**	**22,49**	**1,17**	28,71	28,52	26,97	27,52	27,35	**139,1**	**27,81**	**0,76**	20,84	20,24	24,49	24,15	25,12	**114,8**	22,97	2,25
PJ48	24,01	23,65	21,21	21,75	22,7	**113,3**	**22,66**	**1,2**	28,02	27,85	27,36	28,14	27,26	**138,6**	**27,73**	**0,4**	21,44	20,87	24,71	24,71	25,42	**117,2**	23,43	2,11
PJ49	23,82	24,05	21,25	22,05	23,24	**114,4**	**22,88**	**1,2**	28,75	28,59	27,58	28,35	27,5	**140,8**	**28,15**	**0,58**	22,2	21,25	25,35	25,21	25,65	**119,7**	23,93	2,05
PJ50	23,25	23,75	21,47	22,13	23,5	**114,1**	**22,82**	**0,98**	29,25	29,18	27,51	28,25	27,64	**141,8**	**28,37**	**0,82**	22,64	22,31	25,56	25,43	25,15	**121,1**	24,22	1,6
Somme	1026	1102	1060	967,6	1066	**5221**			1250	1210	1225	1221	1242	**6148**			939	902,3	1062	1004	1108	**5015**		
Moyenne	20,52	22,04	21,2	19,35	21,31	**20,88**			25	24,21	24,5	24,41	24,84	**24,59**			18,78	18,05	21,25	20,07	22,17	**20,06**		
Ecart-	2,537	1,259	1,165	1,491	1,77	**1,644**			2,932	3,215	2,693	2,711	2,247	**2,76**			1,371	1,717	2,895	2,704	1,981	**2,134**		

type																		
Variance	6,438	1,584	1,356	2,224	3,132	**2,947**	8,599	10,33	7,251	7,349	5,049	**7,716**	1,881	2,948	8,381	7,31	3,925	**4,889**
C.V.	12,36	5,71	5,494	7,707	8,305	**7,916**	11,73	13,28	10,99	11,11	9,046	**11,23**	7,302	9,514	13,63	13,47	8,938	**10,57**
Min	15,12	19,1	18,2	16,45	16,52	**15,12**	17,03	17,05	17,53	17,62	18,86	**17,03**	15,36	14,63	15,24	15,85	18,01	**14,63**
Max	24,01	24,05	22,62	22,05	23,75	**24,05**	29,25	29,18	27,58	28,35	27,64	**29,25**	22,64	22,31	25,56	25,43	25,65	**25,65**
Pf – Pi	3,45	4,64	3,25	5,4	5,32	**22,78**	12,22	9,32	9,98	10,63	8,78	**50,93**	5,33	3,64	7,99	6,16	7,14	**30,26**
% G.P.						**24,95**						**56,03**						**33,31**
C.V/Gr	9,1	28,9	7,8	38,3	10,7		10,3	9,57	2,37	4,55	6,2		32,1	50	29,6	0,23	52,6	

Legend :
WD1 : Weight at the first day
T0 : Group of mice as control (exclusively fed standard feed)
T01 : First mouse of control group
T1 : Group of mice fed standard feed supplemented with 25% *Irvingia smithii* almond powder
T12 : Second mouse of Group T1
T2 : Group of mice fed standard feed supplemented with 50% *Irvingia smithii* almond powder
T23 : Third mouse Group T2
Pf – Pi : Live Weight Gain = Final weight – Initial weight