

Wheat Flour Fortification With that of Defatted Seed of *Citrullus lanatus* (Cucurbitaceae): Effects on Organs Biometry

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ABSTRACT

Abstract—This study used to determine the effects of wheat flour fortification with that of defatted seed of *Citrullus lanatus* (Cucurbitaceae) on organ biometry. Thirty rats (30) team up into five per group were fed during 14 days with the six diets prepared: Diet made with casein (RTC); diet containing classic bread (RPC) and diets based on bread in which the wheat flour has been substituted by defatted seed flour of *Citrullus lanatus* (RPFd) at different proportions 5 % (RPFd5); 10% (RPFd10); 15 % (RPFd15); 20% (RPFd20). After the end of the experimental period, animals were sacrificed and kidney, liver, stomach, ileum and spleen were removed and weighted. Result showed that relative kidney weight of rats fed with RTC (0.84 ± 0.08) and RPC (0.90 ± 0.05) were significantly higher ($p \leq 0.05$) than that of rats fed with RPFd (0.69 ± 0.04 to 0.75 ± 0.02). Relative weight of the other organs of rats fed with RPFd (0.24 ± 0.11 to 0.28 ± 0.06) do not show a significant difference ($p \geq 0.05$) when compared to that of rats fed with RTC and RPC. This study suggested that except for kidney, the wheat flour fortification with that of defatted seed of *Citrullus lanatus* have not effects on the biometry of others organs.

Keywords — biometry, organs, alimentary fortification, wheat flour, *Citrullus lanatus*.

I. INTRODUCTION

Fortification of food based on cereal with source rich in protein take a good place among the measure used to avoid malnutrition due to low-protein food and low-energy food (Serna-Saldivar *et al.*, 1999). Malnutrition due to low-protein food and low-energy food is, in Africa, the first cause of nutritional disorders and a public health problem (Burgess, 2005). Côte d'Ivoire, with 22 % of

person suffered, is not spare by this curse (Tchinbidat *et al.*, 2004).

In this case wheat flour has been substituted by *Citrullus lanatus* defatted seed flour at different proportion. The different mixtures obtained have been used to make bread. Results revealed that physicochemical parameters of breads which have been fortified and the zootechnic parameters of rats which consumed these breads were improved (Méité *et al.*, 2008 a, b). Also, this study indicated that the wheat flour-bread fortification with defatted seed flour of *Citrullus lanatus* modify biochemical blood parameters of rats which consumed these breads (Méité *et al.*, 2016). These modifications are the consequences of some failure on organs which regulate the nutritional metabolism? This study was made in order to prove the veracity of this hypothesis. Then, the aim of this study was to determine the effects of wheat flour fortification with defatted seed flour of *Citrullus lanatus* (Cucurbitaceae) on the biometry of organs.

MATERIAL ET METHODS

1.1. Animal material

30 young *albinos wistar* rats weighing (65 ± 5 g) were used. They were 45 to 65 days of age. They were bred in the animal house of UFR Biosciences of the University Félix Houphouët-Boigny of Abidjan, Côte d'Ivoire.

1.2. Food composition in the experimentation

Six kinds of diets were prepared according to a technical sheet offered by the Official Methods of Analysis AOAC (1975) with some modifications:

- RTC: control diet based on casein like protein reference;
- RPC: diet was made only with wheat flour;
- RPFd: four diets based on bread in which a part of wheat flour were substituted by defatted seed flour of *Citrullus lanatus* in a proportion 5 % (RPFd5), 10 % (RPFd10), 15 % (RPFd15) and 20 % (RPFd20).

All the diets were equilibrated in vitamin and ash content. Energizing adjustment were performed using maize oil and maize starch « Maizena» found in the trade. Sugar was used to make the diets attractive.

1.3. Animal feeding

Animals were distributed forming homogeneous groups according to their weight. Each group (five per group) was put individually in a metabolic cage and maintained under standard laboratory conditions (temperature 25±2°C) with dark and light cycle (12h/24h).

The experimentation was conducted during 14 days. Before the commencement of the real experimentation two days was taken to acclimatize the animals to this condition with a switchboard ailment call FACI. During the 14 days of experimentation each group of rats were fed *ad libitum* with a diet composed. After the 14 days of experimentation, animals were sacrificed and organs such as kidney, liver, stomach, ileum and spleen were removed.

1.4. Removal of organs and determination of biometric parameters

1.4.1. Removal of organs

At the end of the experimentation, animals were anaesthetized with chloroform and after that were sacrificed. Liver, kidney, spleen, stomach and ileum which is a part of small intestine, were removed and weighted.

Determination of relative organ weight

Relative organ weight was expressed in percentage of each animal body weight obtained at the last weighing during the experience process. Relative organ weight was determined according to this formula:

$$\text{Relative organ weight} = \frac{\text{organ weight}}{\text{final body weight of the animal}} \times 100$$

1.5. Statistical methods

The experimental results were expressed mean±sem. Data were assessed by the method of analysis of ANOVA and Newman-Keuls test thanks to STATISTICA 6.0 Software. The level $p \leq 0.05$ was considered as the cut-off value for significance. Histograms were made using Graph Pad Prism 5.0 Software.

II. RESULTS

2.1. Organs regulator of nutritional metabolism

2.1.1. Relative kidneys weights

Relative kidneys weight of animals fed with diet RTC was 0.84±0.08 and 0.90±0.05 for rats fed with diet RPC. Rats fed with diets RPFd had relative weights of kidneys which were ranged between 0.69±0.04 and 0.75±0.02. These relative weights did not show a significant difference ($p \geq 0.05$) between each other. On the other hand, these relative weights were inferior ($p \leq 0.05$) to that of rats fed with diets RTC and RPC. (Table I)

2.1.2. Relative liver weight

Relative liver weights were ranged between 4.44±0.71 and 4.84±0.49 for rats fed with diets RTC and RPC respectively.

Relative liver weights of rats fed with diets RPFd were ranged between 4.67±0.61 and 5.06±0.98. Statistical analysis indicated that all the relative liver weights did not show a significant difference ($p \geq 0.05$) when compared to each other. (Table I)

Table I: Relative weight of kidneys and liver of rats fed with the different diets

Diets	Kidneys	Liver
RTC	0.84±0.08 ^{ab}	4.44±0.71 ^a
RPC	0.90±0.05 ^{ab}	4.84±0.49 ^a
RPFd5	0.74±0.12 ^a	4.67±0.61 ^a
RPFd10	0.72±0.02 ^a	4.85±1.11 ^a
RPFd15	0.75±0.02 ^a	5.06±0.98 ^a
RPFd20	0.69±0.04 ^a	4.69±0.89 ^a

Each value is the mean ± SEM of five rats

^{a,b} There is no significant difference ($p \geq 0.05$) between the two values in the table when designer by the same letter

RTC: Diet made with casein like protein source,
 RPC: Diet containing classic bread based on wheat flour,

RPFd: Diets based on bread in which a part of the wheat flour has been substituted by defatted seed flour of *Citrullus lanatus* at different proportion 5 % (RPFd5); 10 % (RPFd10); 15 % (RPFd15); 20 % (RPFd20).

Relative kidneys weight of rats fed with diets RPFd were inferior ($p \leq 0.05$) to that of animals fed with diets RTC and RPC. Relative liver weights did not show a significant difference ($p \geq 0.05$) between each other whatever the diets used

2.2. Digestive tract organs

2.2.1. Relative stomach weight

Rats fed with diets RTC and RPC had relative stomach weights which values were 0.99±0.10 and 1.00±0.19 respectively. Relative stomach weight obtained on rats fed with diets RPFd were 0.96±0.13; 0.90±0.07; 0.84±0.11 and 0.88±0.10 from diets RPFd5; RPFd10; RPFd15 and diets RPFd20 respectively.

Statistical analysis indicated that relative weight of empty stomach did not show a significant difference ($p \geq 0.05$) between each other. (Table II)

2.2.1. Relative ileum weight

Rats fed with diets RPFd had relative ileum weights vary from 0.32±0.07 to 0.43±0.09. There had any significant difference ($p \geq 0.05$) of ileum weight between rats fed with diets RTC and RPC; these relative ileum weights were 0.40±0.12 and 0.41±0.05 respectively. (Table II)

Table II: Relative weight of stomach and ileum of rats fed with the different diets

Diets	Stomach	Ileum
RTC	0.99±0.10 ^a	0.40±0.12 ^a
RPC	1.00±0.19 ^a	0.41±0.05 ^a
RPFd5	0.96±0.13 ^a	0.40±0.16 ^a
RPFd10	0.90±0.07 ^a	0.43±0.09 ^a
RPFd15	0.84±0.11 ^a	0.34±0.04 ^a
RPFd20	0.88±0.10 ^a	0.32±0.07 ^a

Each value is the mean ± SEM of five rats

^a There is no significant difference ($p \geq 0.05$) between the two values in the table when designer by the same letter

RTC: Diet made with casein like protein source,

RPC: Diet containing classic bread based on wheat flour,

RPFd: Diets based on bread in which a part of the wheat flour has been substituted by defatted seed flour of *Citrullus lanatus* at different proportion 5 % (RPFd5); 10 % (RPFd10); 15 % (RPFd15); 20 % (RPFd20).

Relative stomach and ileum weights did not show a difference ($p \geq 0.05$) between all the animals used in the study.

2.3. Lymphoid organ: spleen

Relative spleen weight was 0.26±0.03 for rats fed with diet RTC. For rats fed with diet RPC the relative spleen weight was 0.39±0.11.

As for rats fed with diets RPFd, the relative spleen weights were 0.33±0.17; 0.30±0.04; 0.29±0.04 and 0.25±0.06 for diets RPFd5; RPFd10; RPFd15 and diets RPFd20 respectively.

Statistical analysis did not show a significant difference ($p \geq 0.05$) between all the relative spleen weights when compared to each other. (Figure 1)

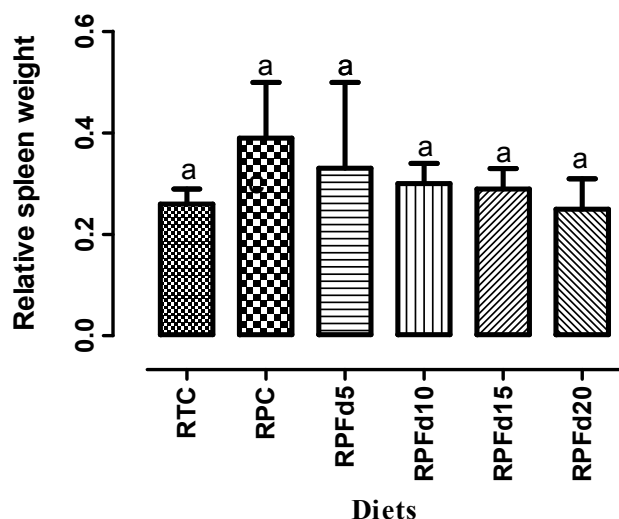


Fig.1: Relative spleen weight of rats fed with the different diets

Each value is the mean ± SEM of five rats

a There is no significant difference ($p \geq 0.05$) between the two values in the histogram when designer by the same letter

RTC: Diet made with casein like protein source,

RPC: Diet containing classic bread based on wheat flour,

RPFd: Diets based on bread in which a part of the wheat flour has been substituted by defatted seed flour of *Citrullus lanatus* at different proportion 5 % (RPFd5); 10 % (RPFd10); 15 % (RPFd15); 20 % (RPFd20).

Relative spleen weight did not show a significant difference ($p \geq 0.05$) between each other whatever the diet consumed by rats used in the study.

III. DISCUSSION

Weights variations of kidneys on rats fed with diets RPFd showed a decrease. This decrease of kidneys weight varied from 10.75 % to 17.85 % and from 16.66 % to 23.33 % in comparison to relative kidneys weight of rats fed with diets RTC and RPC respectively.

These observations are agreed with that of Bouafou *et al.* (2011). In fact, Bouafou *et al.* (2011) described a decrease of kidneys weights on rats which ingested diets based on a mixture of fisher flour and dry maggot-flour in comparison to kidneys of rats fed with only fisher powder.

Kidney atrophy found on rats fed with diets RPFd could explain a serious pathology (Adrian *et al.* 1991; Williams, 1994).

It was appear that, the weights of liver, stomach, ileum and spleen, removed on rats which consumed the experimental diets RPFd were not subjected to significant modification of weight in comparison to that of rats which consumed diet RTC and diet RPC. These results are different to that of Finke *et al.* (1989) and Kouakou *et al.* (2016). Finke *et al.* showed that the rats fed with diets containing a high quantity of locusts flour used as the only protein source, had diarrhea and their stomachs and colons weight were increased. This difference could be explained by the fact that diets based on locusts flour are rich in lipids contrary to diets RPFd used in this study. Kouakou *et al.* (2016) indicated that the organs biometry for rats submitted to Anagobaka diet has revealed the diminution of 34.70 % from the weight of ileum and the raise of 21.20 % in weight of liver compared to those of the rats fed with wheat Cerelac.

IV. CONCLUSION

This study was made in order to evaluate the effect of the use of wheat flour fortified with *Citrullus lanatus* (Cucurbitaceae) defatted seed flour at different proportion on the organs biometry of rats fed with diets constituted.

The fortification induced decrease of kidneys weights on rats fed with diets RPFd compared to that of rats fed with diets RTC and RPC. On the other hand, other organs such as liver, stomach, ileum and spleen were not subjected to significant modifications when compared to modifications observed on rats fed with the classic diet (RTC) and the classic bread (RPC).

Complementary studies are necessary to know if these modifications have some pathological consequences on the histology of the organs.

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