International Journal of Biosciences (IJB)
ISSN: 2220-6655 (Print) 2222-5234 (Online)
Vol. 1, No. 5, p. 65-70, 2011
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Incorporation of a dried maggots' meal in growing rats diets: pathological risks?

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Received: 07 September 2011
Revised: 26 September 2011
Accepted: 27 September 2011

Key words: Dried maggots, meal-growing rats-plasma, biochemical parameters-organ, biometrics.

Abstract

Three groups of ten rats in growth fed with three diets differing only in the amount of dried maggots meal (DMM): 2.5%, 5% and 7.5%: $DMM^{2.5}$, DMM^{5} and $DMM^{7.5}$. Assay of plasma biochemical parameters of all the rats did not detect diseases or physiological abnormalities. However, biometrics kidneys and livers of rats showed changes. The kidneys of rats decreased weight of 4.00%, 1.30% and 2.70% respectively in diets $DMM^{2.5}$, DMM^{5} and $DMM^{7.5}$. As for the liver, their weight increased by 1.10%, 3.00% and 12.40% respectively with diets $DMM^{2.5}$, DMM^{5} and $DMM^{7.5}$. These observations may reflect histopathological abnormalities of the kidneys and livers of rats that are to detect.

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Introduction

Dried maggots meal (DMM) has been at a strictly nutritional, a good source of dietary protein in growing rats (Bouafou, 2007; Bouafou et al., 2007).However, to prescribe safely, its use in animal feed, it is necessary to conduct further investigations. Because, it is an unconventional source of dietary protein. Here is what justifies the study of plasma biochemical parameters and biometrics organs of growing rats, fed to the DMM. Indeed, the interest of the determination of plasma biochemical parameters in studies of nutrition is well established. The excess or deficit of production of a substance synthesized by an organ is indicative of a malfunction. This is an indirect way of exploring organs called metabolic regulators and a means of assessing the metabolism of nutrients. Similarly in studies of nutrition, weight changes of organs involved in digestion and nutrient absorption is an indirect way of exploration (Adrian et al., 1991). Atrophy or hypertrophy of an organ, if not physiological, may indicate pathology of it or metabolic disorder nutrition in it. The aim of this study is to assess the health hazards of ingesting DMM in growing rats, by measuring their plasma biochemical parameters and biometrics of two regulative organs of nutrition (kidney and liver).

Materials and methods

The following materials and methods are the same as those used by Bouafou et al. (2007, 2008 and 2011).

Animals and housing

Male rats of Wistar strain growth (average weight: 56-66 g) were housed in individual metabolic cages. These cages are equipped with racks and bottles to feed and water the animals.

Production of maggots, of dried maggots' meal (DMM) of fish meal (control) and corn meal

The production technique of maggots, their meal, fish meal and corn meal is the same used by Bouafou et al. (2008). Yam peelings and scraps of fresh fish arranged in layers in a half-barrel, were exposed to flies. After 24 hours of seeding substrates, the half-barrel was covered. Four days later, the maggots were harvested in boiling water. The maggots collected were dried in an oven at 70 ° C for 24 hours. They were then ground in a blender moulinex for dried maggot's meal (DMM). Fish meal was produced in the same way that the FAS, from fish (herring) expense, purchased a fish. Cornmeal used in this experiment is that of commerce. It is white. Corn is commonly used for animal feed. This is the main source of energy of the system due to its high levels of starch and fatty acids (Inra, 1989).

Formulation of diets

Diets were prepared by the method of Bouafou et al (2011). Three isocaloric diets and isoprotein, differing only in their content of DMM are prepared. These diets are $DMM^{2.5}$, DMM^{5} and $DMM^{7.5}$ containing respectively 2.5%, 5% and 7.5% of DDM (Table 1).

Table 1. Formulation of experimental diets (g/kg of dry matter).

Dietary constituents			$DMM^{2.5}$	DMM^{5}	$DMM^{7.5}$
Protein	Corn meal	6%	633.91 g	633.91 g	633.91 g
	Fish meal	10%	81.57 g	40.78 g	0 g
	DMM		95.73 g	143.60 g	191.46 g
Mineral supplement UAR-205		7%	70 g	70 g	70 g
Vitamin supplment UAR-200		1%	10 g	10 g	10 g
Cellulose and agar-agar		3%	9.47 g	9.47 g	9.47 g
Starch « Merck »			0 g	0 g	0 g
Corn oil			107 g	100 g	92,74 g
Total dry matter			1000 g	1000 g	1000 g
Gross Energy (kcal/kg of dry matter)			4 200	4 200	4 200

DMM^{x}: x represents the rate of DMM of the diet. The gross energy of diets was calculated by reference to the values of combustion of different nutrients on the basis of 4 kcal for 1 g protein, 4 kcal per 1 gram of carbohydrate and 9 kcal for 1 g of lipid.

Experimental conditions and composition of groups of animals

The experimental room had a temperature of 26 ° C, with humidity between 70 and 80%. Four lots of ten growing rats are submitted to each diet.

Driving of experience

During 15 days, the diets are distributed ad libitum once a day (between 6 am and 7 pm and a half and half) in the form of puree. Water is served at will and renewed every three days (Bouafou et al., 2011).

Determination of plasma biochemical parameters

These parameters were measured on serum obtained after centrifugation of whole blood, at the Laboratory of Medical Biochemistry, University of Cocody-Abidjan. Assays have complied with the requirements of reagents kits of the Spanish group SPINREACT SA (Fawcett and Scoot, 1960; Budesinky, 1969; Dingeon et al., 1975; Young et al., 1975). The value of each of the plasma biochemical parameters (mg / dl) was determined from the following equation: P = [OD sple/OD standard] x concentration standard, where P is the plasma biochemical parameters to be determined, sple OD (optical density of the sample) is equal to 610 nm and the standard concentration is 200 mg / dl.

Sampling and weighing of organs

At the end of the experimental period, rats were anesthetized and then sacrificed for collection of kidney and liver. The removed organs were dehumidified on toilet paper and weighed on a precision balance Sartorius sensibility 0.001 g.

Statistical control

Comparisons of values of plasma biochemical parameters on the one hand, and the weight of other organs, were performed using the software STATISTICA, version 6.0, by the Newman Keuls test at 0.01.

Results

Study of plasma biochemical parameters

Blood urea and creatinine

The values of blood urea and creatinine blood levels of all animals are recorded in table 2. They vary little and are statistically equal to each other ($p<0.01$).

Table 2. Values of plasma urea and creatinine.

Diets	Values of plasma biochemical parameters (mg/ml)	
	Urea	Créatinine
DMM$^{2.5}$	0.29 ± 0.10 ^{a}	0.76 ± 0.09 ^{b}
DMM^{5}	0.21 ± 0.06 ^{a}	0.72 ± 0.11 ^{b}
DMM$^{7.5}$	0.23 ± 0.05 ^{a}	0.71 ± 0.03 ^{b}

In each column, mean values followed by their standard deviations assigned the same letter show no statistically significant difference.

Table 3. Values of plasma triglycerides and cholesterol.

Diets	Values of plasma biochemical parameters (mg/ml)	
	Triglycerides	Cholesterol
DMM$^{2.5}$	0.45 ± 0,14 ^{e}	4.21 ± 0.42 ^{f}
DMM^{5}	0.49 ± 0,00 ^{e}	3.50 ± 0.58 ^{f}
DMM$^{7.5}$	0.50 ± 0,18 ^{e}	4.00 ± 0.34 ^{f}

In each column, mean values followed by their standard deviations assigned the same letter show no statistically significant difference.

Table 4. Values of glycemia.

Diets	Values of glycemia (mg/ml)
DMM$^{2.5}$	2.30 ± 0.18 ^{g}
DMM^{5}	1.88 ± 0.18 ^{g}
DMM$^{7.5}$	2.25 ± 0.31 ^{g}

In each column, mean values followed by their standard deviations assigned the same letter show no statistically significant difference.

Table 5. Values of the ratio of plasma calcium and phosphorus.

Diets	Values of the ratio of plasma calcium/ phosphorus
DMM$^{2.5}$	0.85 ± 0.09 ^{g}
DMM^{5}	0.96 ± 0.20 ^{g}
DMM$^{7.5}$	1.00 ± 0.05 ^{g}

In each column, mean values followed by their standard deviations assigned the same letter show no statistically significant difference.

Triglyceridemia and serum cholesterol

Triglyceridemia and serum cholesterol in young rats are shown in table 3. Statistically, there is no significant difference ($p<0.01$) between triglyceridemia levels in young rats of all lots. It is the same for serum cholesterol.

Table 6. Evolution of kidney weigh.

Diets	(Kidney weight / body weight)) x 100
DMM$^{2.5}$	0.73 ± 0.04 ^{b}
DMM^{5}	0.75 ± 0.05 ^{b}
DMM$^{7.5}$	0.74 ± 0.00 ^{b}

In each column, mean values followed by their standard deviations assigned the same letter show no statistically significant difference.

Table 7. Evolution of liver weight.

Diets	(Liver weight / body weight) x 100
DMM$^{2.5}$	3.98 ± 0.13 ^{d}
DMM^{5}	4.06 ± 035 ^{d}
DMM$^{7.5}$	4.43 ± 0.15 ^{d}

In each column, mean values followed by their standard deviations assigned the same letter show no statistically significant difference.

Glycemia

Blood glucose levels of young rats are reported in table 4. Blood glucose levels in rats fed diet DMM^{5} (1.88 ± 0.18) seems low although statistically ($p<0.01$), it doesn't differ from those of animals of other groups.

Calcium / phosphorus ratio

The calcium / phosphorus ratio of young rats are shown in table 5. Statistically, there is no significant difference ($p <0.01$) between the calcium / phosphorus ratio of young rats of all groups.

Evolution weight of kidney and liver

Kidneys

The kidney weight, reported to weight of rats is listed in Table 6. They did not differ significantly with respect to each other.

Livers

The liver weight relative to body weight of rats, measured in rats subjected to different regimes are noted in Table 7. These weight ratios show no significant difference between them.

Table 8. Comparison of plasma biochemical parameters of rats fed a diet of fish and diets with DMM.

Plasma biochemical parameters	Rats in the diet containing fish meal	Rats in the diet DMM$^{2.5}$	Rats in the diet DMM^{5}	Rats in the diet DMM$^{7.5}$
Uremia	0.27 ± 0.07*	0.29 ± 0,10	0.21 ± 0.06	0.23 ± 0,05
Creatinine	0.69 ± 0.06 *	0.76 ± 0,09	0.72 ± 0.11	0.71 ± 0.03
Triglycedemia	0.61 ± 0.18 *	0.45 ± 0.14	0.49 ± 0.00	0.50 ± 0.18
Cholesterolemia	4.00 ± 0.00 *	4.21 ± 0.42	3.50 ± 0.58	4.00 ± 0.34
Glycemia	2.13 ± 0.31 *	2.30 ± 0.18	1.88 ± 0.18	2.25 ± 0.31
Ratio calcium/ phosphorus	0.88 ± 0.12 *	0.85 ± 0.09	0.96 ± 0.20	1.00 ± 0.05

(*) Adapted from Bouafou et al. (2011)

Discussion

It appears that the values of the different plasma biochemical parameters of all rats are statistically equal. These values are all comparable to those of rats fed fish meal (Table 8) which is a conventional food protein (Bouafou et al., 2011). Thus, plasma biochemical parameters do not reveal here abnormalities in the kidneys and livers of rats ingesting diets incorporating 2.5%, 5% and 7.5% of DMM.

In rats fed 10% of DMM, there was a decrease in the weight of their kidneys to 6.60% and an increase in liver weight of 10.60% (Bouafou et al., 2011). These observations presaged even pathological tissue changes that were confirmed by histological and histopathological studies of these organs (Bouafou, 2007). In this study, biometrics kidneys and livers of rats was also performed. Compared to kidney weights and liver of rats fed fish meal, it appears as follows. The kidneys of rats in diets DMM$^{2.5}$, DMM^{5} and

DMM$^{7.5}$ have been decreases 4.00%, 1.3% and 2.70% of weight respectively. The kidneys of rats lot DMM^{5} were little affected. But, the decrease in kidney weight can be lifted by a simple hypoplasia, if not pathological consequences for animals (Broet et al., 2004).

Table 9. Comparison of kidney weight of rats fed a diet of fish meal and those of rats fed diets DMM.

Diets	(Kidney weight / body weight) x 100	% Decrease in kidney weight
Diet containing fish meal	0.76 ± 0.06 *	-
DMM$^{2.5}$	0.73 ± 0.04	4.00
DMM^{5}	0.75 ± 0.05	1.30
DMM$^{7.5}$	0.74 ± 0.00	2.70

(*) Adapted from Bouafou et al. (2011)

Table 10. Comparison of kidney weight of rats fed a diet of fish meal and those of rats fed diets FAS.

Diets	(Liver weight / body weight) x 100	% Decrease in liver weight
Diet containing fish meal	3.94 ± 0.19	-
DMM$^{2.5}$	3.98 ± 0.13	1.10
DMM^{5}	4.06 ± 0.35	3.00
DMM$^{7.5}$	4.43 ± 0.15	12.40

(*) Adapted from Bouafou et al. (2011)

As for the weighing of the livers, it shows their increase of 1.10%, 3.00% and 12.40% (Table 10) (Bouafou et al., 2011) respectively for animals under diets DMM$^{2.5}$, DMM^{5} and DMM$^{7.5}$. The most important change in liver weight was detected in rats consuming the diet DMM$^{7.5}$. These findings may be evidence of histopathological abnormalities of the kidneys and livers of rats whose organs have changed weight (Seronie et al. 2004; Bouafou et al., 2011). The extent of these histopathological abnormalities was correlated with the degree of variation in organ weights at issue. Rats that consumed the diet DMM^{5} seem least affected by changes in weight of these two regulators of nutrition. Contrary, increased weight of livers of growing rats may be inconsequential. According to a report by the European Union, the livers of rats consuming maize NK 603 were increased weight, but without histopathological damages (Ue, 2003).

Conclusion

Assay of plasma biochemical parameters carried out in growing rats fed diets DMM$^{2.5}$, DMM^{5} and DMM$^{7.5}$ containing respectively 2.5%, 5% and 7.5% of DMM revealed no abnormalities or organ dysfunction.

They are statistically equal. However, the weight of their kidneys and livers are changed. The kidneys have undergone weight loss of 1.30% (in rats fed DMM^{5}) to 4.00% (in rats fed DMM$^{7.5}$). Livers increased in weight ranging from 1.10% (subject ingesting the diet DMM$^{2.5}$) to 12.40% (rats fed diet DMM$^{7.5}$). The weights of kidneys and livers of rats under regime DMM^{5} appear little changed. These observations suggest possible damage to structural and functional of these organs in proportion to their weight change. Further research is needed to prescribe the DMM in animal feed.

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