101 - ANALYSIS OF GLYCEMIC BEHAVIOR IN ADULT RATS WHEN SUBMITTED TO THE DIETS WITH DIFFERENT CONCENTRATIONS OF CARBOHYDRATES AND TRAINING OF SWIMMING

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1. INTRODUCTION

The nutrition corresponds to the general processes of ingestion and nourishing substance conversion in nutrients that can be used to keep the organic function. These processes involve nutrients that can be used with energy purpose (carbohydrates, lipids and proteins), for the construction and repair of fabrics (proteins, lipids and minerals), for construction and maintenance of the skeleton system (calcium, match and proteins) and to regulate the physiology corporal (vitamins, minerals, lipids, proteins and water). To the preferential use of carbohydrates on lipids as an energy substratum for the exercised muscle being, it is related directly with the intensity of exercise and the initial levels of glycogen and, inversely related with the model of exercise and the level of physical conditioning. Human organism stores much more fat that carbohydrate, being thus, we have a contrast in that it is related to the limited amount of stored carbohydrates, being these well lesser supplies that of lipids cited previously. Although the reservoir of fats in the organism (subcutaneous and muscular) either bigger that of CHO, its availability as energy substratum during the exercise is well more complex and depends on some factors, becoming the accessible supplies of CHO of faster form, not depending on as many restrictive metabolic and hormonal factors (RIEGEL, 1999).

MILLER (1991) and AUGUSTUS (1994) detach that even so assumptions exist considering positive the energy rocking as main the determinative one of the fat deposition, some studies on the feeding in human beings present resulted divergent. For example, evidences exist that obeses individuals do not consume more calories that the not obeses ones (SCOTELLARO, 1991), standing out the composition of the diet as so or more important factor that the total caloric amount of the same one, for the installation of the obesity (BLAIR, 1996). An exchange in the ingestion of lipids for simple carbohydrates is also had, resulting in an increase caloric in the feeding, taking itself, also, to an increase in the obesity, that acts as factor of risk to the appearance of diabetes mellitus type II. With base in this, this study aims to verify the relations between consumption of simple carbohydrates in the diet and glycemic behavior in Wistar rats submitted to the swimming procedure.

2. MATERIALS AND METHODS

It was used 32 female Wistar rats (divided in 4 groups), weighing in the beginning of the experiment between 200 and 300 g, adults (60 days in the beginning of the experiment), being 20 animals for the experimental group that was exercised (being 10 rats in the group with normal diet and 10 rats in the group with carbohydrate rich diet) and 12 animals for the group control that was kept sedentary (being 6 rats in the group with normal diet and 6 rats in the group with carbohydrate rich diet). The experiment was carried through in the Laboratory of Biochemistry and Physiology of the Exercise of the ESEF-UFPel. The animals were kept in collective river steamers (maximum of 4 animals for river steamer) and fed with proper ration for rodents and "ad libitum" water, and kept in room with a 12 hours/12 hours cycle of light/dark of, initiating to the 6 a.m.. The swimming procedure happened between 4 p.m. and 8 p.m.

The animals, before been submitted to the swimming procedure, were adapted and trained in the aquatic exercise, in way that they could support the time of 60 minutes of continuous exercise in a way to present, when sacrificed, biochemists and physiological chronicles adaptations in consequence of the physical training of continuous standard and moderate intensity, similar to what happens with human beings submitted when exposed to the same protocol of physical exercise (ÅSTRAND & RODAHL, 1977; GREEN et al., 1978; WITHERS et al., 1982; JACKSON et al., 1995). In this direction, the intensity used in this study was moderate e, in way, it was used a lead overweight of 5% of the corporal weight of the imprisoned animals to the trunk of each one through an rubber band (KOKUBUN, 1990).

The swimming collective system used in this work was developed in rectangular tanks of 60 cm of width, 80 cm of length and 100 cm of height, linked through a central office of bombardment and water heating (VIEIRA et al., 1988). The water kept in depth of 80 cm was recirculated through the central system adjusted to keep the temperature 32° C.

The necessary period so that the training produces the necessary adaptations was 10 weeks. The animals of the experimental group exercised 5 times a week, during 1 hour a day. The animals were weighed weekly, on Wednesdays, so that the load always varies if there is any alteration in the in the animal weight.

To investigate the effect of the carbohydrate rich diet, 5% of simple carbohydrate (sucrose) was added in water consumed during the corresponding period to the active cycle of the rats (nocturnal), after the swimming program. In the period of the morning, between 7 and 8 hours, the water was measured for control of the consumption. After to this pure water was placed for consumption, rats' not active period, preceding to the swimming program. The water was given “ad libitum”. The rats without carbohydrate rich diet received pure water, not being measured its consumption.

The chow used for group the carbohydrate rich diet as for the group without diet presented the same composition. The used chow possess around 47% of carbohydrate, 22% of proteins, 20% of lipids, 10% of mineral salts (SUPPRA LAB), and it was weight once a day for the group with diet, to control the consumption of ingested ration, and for determination of the amount of carbohydrate ingested. It was weighed during the entire swimming program. The averages of the consumption of ration and water for each box and rat were calculated.

After to be submitted the 12 hours without eating, the animals were sacrificed by decapitation, using guillotine, collecting their blood in glass pipes without anticoagulant. The blood was centrifuge in 3000 rpm per 3 minutes, being separate the serum for free fatty acid and glucose determination, total cholesterol and fractions (HDL and LDL) and triglycerides. The total cholesterol and fractions (HDL and LDL) were determined through kits for blood analyses (LABTEST).

Was used the analysis of factorial variance for the comparison between the averages (2 x 2). When the F was significant, to locate the differences it was used the test of Tukey. The values were expressed as average and standard deviation, being adopted the level of significance of $p<0,05$. Statistical package STATISTICA for Windows was used, version 5.0, from Statsoft, Inc.

3. RESULTS E DISCUSSION

Table 1. Averages and shunting line-standard of the analyzed dependent variable.

	Sedentary without Diet	Sedentary with Diet	Trained without Diet	Trained with Diet
Glycemia (mg/dL)	134,17 ± 83,81	194,18 ± 149,84	95,40 ± 23,43	159,10 ± 75,95
Ration/day (g/day)	18,47 ± 0,30	12,05 ± 0,71	19,56 ± 1,09	13,14 ± 0,67
Water/day	-.-.-.-.	113,5 ± 1,26	-.-.-.-	111,60 ± 14,97
CHO/day (g/day)	-.-.-.-.-	5,66 ± 0,04	-.-.-.-.-	5,58 ± 0,75

Table 2 presents the averages and shunting line-standard of the glycemia dependent variable. The variance analysis (Table 3) sample that did not have significant difference in the glycemia of the groups, but showed to a trend the significance (p = 0,055979) with regard to independent 0 variable diet (animal with hiperglicidic diet x animal without hiperglicidic diet).

Or either, the rats that had received the diet hiperglicidic, sedentary or trained, had shown glycemia higher than those that had not received the diet.

Table 2. Averages and shunting line standard of the glycemia variable.

	Sedentary without Diet	Sedentary with Diet	Trained without Diet	Trained with Diet
Glycemia (mg/dL)	134,17 ± 83,81	194,18 ± 149,84	95,40 ± 23,43	159,10 ± 75,95

These results are coherent with those presented by ROMBALDI (1996) in its study where groups of fed rats had more had the serum glucose raised significantly of that the glycemia of the fasted groups. According to this exactly author, the rats that had been fed and fasted and had received suplementation with carbohydrates had presented greater glucose concentrations that the ones that had received water pure. The significance lack statistics in this variable in our study, when compared with the ROMBALDI study (1996), probably it can be explained by the model of exercise used in that study and by the fact to have immediately supplemented the animals before the study through orogastric sounding lead. While our work used moderate exercise of long duration, the author used intermittent exercise of high intensity. Our study he normally used the biggest load of glycids in the feeding of chronic form, instead of using the process to supply carbohydrates through supplemental of acute form.

Table 3. Summary of the analysis of variance in relation to the effect of the alimentary state and exercise on the glycemia.

variable	F	Probability
Exercise (trained or sedentary)	1,426	0,242324
Diet (with or without)	3,975	0,055979
Exercise x diet	0,002	0,961557

According to COMMEFORD et al. (2002), that in its study they had examined the effect of diets enriched with sucrose and alive fat in on neoglycogenese, glucose-6-fosfato, movement of glycokinase, had demonstrated that the relatively short chronic exposition to these diets is capable to increase neoglicogenese, the expression of the catalytic subunity of G-6-fosfatase and the activity of this same enzyme. Our results differ from boarded literature due to have themselves worked with females, while the ones that we use revision to present given referring the male or human rats and different models of exercise. It is also standed out, that the estral cycle of the rats must be taken in consideration, therefore can present differences in the glycemia during you make them of the cycle. ROMIJIN et al. (2000), had also found resulted different of the joined ones in our study, where the plasmatic glucose concentration and the average of sanguine glucose appearance had increased significantly in relation to the intensity of the exercise.

Exactly having a significant difference in the ratio/day consumption (Table 5), it did not have relation with the serum glycemia. Also significant difference in the carbohydrated/day water consumption (Table 6) and in the consumption of carbohydrate/day met (Table 7) enters the groups with diet and without diet, but without implying in difference statistics in the serum glucose. We can suggest that these differences say respect the biggest use of the glucose as energy substratum during the exercise (for being of long duration), what we cannot affirm due the lack of evidences in literature. The table to follow sample the averages and shunting lines standard of the 0 variable ration, water and Cho per day. In relation the dependent 0 variable amount of consumed ration/day, observed effect of the physical exercise and the diet (Table 5), of such luck that bigger consumption of ration/day for the trained or sedentary rats without diet was observed when compared with the trained or sedentary animals with diet.

Table 4. Averages and shunting line-standard of the dependent variable amount of consumed ration/day, amount of ingested water/day and amount of consumed CHO/day

	Sedentary without Diet	Sedentary with Diet	Trained without Diet	Trained with Diet
Ration/day (g/day)	18,47 ± 0,30	12,05 ± 0,71	19,56 ± 1,09	13,14 ± 0,67
Water/day	-.-.-.-.	113,5 ± 1,26	-.-.-.-	111,60 ± 14,97
CHO/day (g/day)	-.-.-.-.-	5,66 ± 0,04	-.-.-.-.-	5,58 ± 0,75

It can be observed, also, one high consumption of carbohydrated water for the rats with diet, as well as a significant increase of the carbohydrates/day consumption (Table 6). This in indicates them that the reduction of the ration/day consumption if must to the fact of the animals have water availability with sucrose for consumption "ad libitum". In the same way a difference was observed significant statistics in that the independent variable says respect to the carbohydrate/day consumption enters the groups in relation diet (Table 7); of form that the sedentary rats had had greater consumption of sucrose in relation the trained ones.

Table 5. Summary of the analysis of variance in relation to the effect of the alimentary state and exercise on the ration/day consumption.

variable	F	Probability
Exercise (trained or sedentary)	14,04	0,000825
Trained without Diet	488,86	0,000000
Exercise x diet	0,0001	0,993189

Table 6. Summary of the analysis of variance in relation to the effect of the alimentary state and exercise on the consumption of Water/day.

variable	F	Probability
Exercise (trained or sedentary)	0,099	0,755942
Trained without Diet	1313,385	0,000000
Exercise x diet	0,099	0,755942

Table 7. Summary of the analysis of variance in relation to the effect of the alimentary state and exercise on the consumption of Carbohydrates/day.

variable	F	Probability
Exercise (trained or sedentary)	0,066	0,798446
Diet (with or witout)	1311,956	0,000000
Exercise x diet	0,066	0,798446

4. CONCLUSION

The acute and permanent effect of the physical exercise imply in a positive modification of the control of the glycemia, since that if it has an adjusted diet, preventing a possible development of Diabetes Mellitus type II, and being able to positively contribute for the improvement in the degree of health and quality of life of all those that to adopt an active style of life.

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ANALYSIS OF GLYCEMIC BEHAVIOR IN ADULT RATS WHEN SUBMITTED TO THE DIETS WITH DIFFERENT CONCENTRATIONS OF CARBOHYDRATES AND TRAINING OF SWIMMING

ABSTRACT

This study aims to verify the relations between consumption of simple carbohydrate in the diet and glycemic behavior in Wistar rats submitted to the swimming procedure. The sample was composed of 32 rats of the Wistar ancestry weighing between 200 and 300 g in the beginning of the experiment, being 20 animals for the experimental group that was exercised and 12 animals for the group control that was kept sedentary, of these there was an exercised group and a sedentary one with hyperglycidic diet, and an exercised group and a sedentary group with normal diet. The hyperglycidic diet consisted of an addition of 5% of sucrose in the water ingested for the animals. The used physical training was the swimming procedure that was carried through five times per week with duration of one hour. In relation to the dependent 0 variable amount of consumed ration/day, observed effect of the physical exercise and the diet in the biggest consumption for the trained or sedentary rats without diet, when compared with the trained or sedentary animals with diet. It was observed, also, a high water consumption carbohydrate for the rats with diet, as well as a significant reduction of the carbohydrate/day consumption. In the same way there was a difference significant statistics in relation to the carbohydrate/day consumption between the groups in relation to the independent variable diet so that the sedentary rats had had greater consumption of sucrose in relation to the trained ones. The variance analysis shows that there was no significant difference in the glycemia of the groups, but showed to a trend the significance ($p = 0,055979$) with regard to the independent variable diet (animal with hiperglycidic diet x animal without hiperglycidic diet). Or either, the rats that had received the diet hiperglycidic, sedentary or trained, had shown glycemia higher than those that had not received the diet.

Key-Words: Physical exercise, Hiperglycidic Diet and glicemic behavior.

ANALYSE DU COMPORTEMENT GLYCEMIQUE DES RATES ADULTES QUAND SOUMISES AUX RÉGIMES AVEC DIFFÉRENTS CONCENTRATIONS DE HYDRATES DE CARBONE ET FORMATION DE NATATION

RESUME

Cette étude objective vérifier les relations entre consommation de hydrates de carbone simple dans le régime et le comportement glycemique à des femelles Wistar soumises à procédure de natation. L'échantillon s'est composé de 32 rates de l'ascendance Wistar en pesant au début de l'expérience entre 200 et 300 g, étant 20 animaux pour le groupe expérimental qui a fait dês exercices et 12 animaux pour le groupe contrôle qui est maintenu sédentaire, de ceux-ci avait un groupe exercé et une sédentaire avec regime hiperglicidique, et un groupe exercé et un groupe sédentaire avec régime normal. Le régime hiperglicidica consistait à l'addition de 5% de saccharose dans l'eau ingérée par les animaux. La formation physique utilisée a été la procédure de natation réalisée cinq fois par semaine avec une duration d'une heure. Concernant la variable dépendante quantité de ration/jour consommée, s'est observée l'effet de l'exercice physique et du régime dans le plus grand consummation par les rates instruites ou sédentaires sans régime quand comparées aux animaux instruits ou sédentaires avec régime. On a observé, aussi, une haute consommation d'eau d'hydrates de carbone par les rats avec régime, ainsi qu'une diminution significative de la consommation de hydrates de carbone/jour. De la même manière a eu une différence statistique significative en ce qui concerne à la consommation de hydrates de carbone/jour entre les groupes, concernant variable indépendante régime de forme que les rates sédentaires ont eu plus grande consommation de saccharose concernant aux entraînées. L'analyse de variance échantillon montre qui n'a pas eu différence significative dans la glycemie des groupes, mais a montré une tendance l'importance ($p = 0,055979$) concernant variable indépendante régime (animaux avec régime hiperglicidique x animaux sans regime hiperglicidique). C'est-à-dire, les rates qui ont reçu le régime hiperglicidique, sédentaires ou entraînés, ont montré glycemie plus élevée que celles qui n'ont pas reçu le régime.

Mots Clés : Exercice Physique, Régime Hiperglicidique et comportement glycemique.

ANÁLISIS DEL COMPORTAMIENTO GLICÉMICO EN RATAS ADULTAS CUANDO SOMETIDAS LA DIETAS CON DIFERENTES CONCENTRACIONES DE CARBOHIDRATOS Y ENTRENAMIENTO DE NATACIÓN

RESUMEN

Este estudio objetivó verificar las relaciones entre consumo de carbohidrato simple en la dieta y comportamiento glicémico en ratas Wistar sometidas a rocedimiento de natación. La muestra fué compuesta de 32 ratas del linaje Wistar pesando en el inicio del experimento entre 200 y 300 g, siendo 20 animales para el grupo experimental que fué ejercitado y 12 animales para el grupo control que fué mantenido sedentario, de estos había un grupo ejercitado y un sedentario con dieta hiperglicérica, y un grupo ejercitado y un grupo sedentario con dieta normal. La dieta hiperglicérica consistía en adición del 5% de sacarosa en el agua ingerida por los animales. El entrenamiento físico utilizado fué el procedimiento de natación que era realizado cinco veces por semana con duración de una hora. En relación a la variable dependiente cantidad de ratio/día consumida, se observó el efecto del ejercicio físico y de la dieta en el mayor consumo por las ratas entrenadas o sedentarias sin dieta cuando comparadas a los animales entrenados o sedentarios con dieta. Se observó, también, un alto consumo de agua carboidratada por las ratas con dieta, así como una disminución significativa del consumo de carbohidratos/día. De la misma forma hubo una diferencia estadística significativa en lo que concierne al consumo de carbohidratos/día entre los grupos en relación a la variable independiente dieta de forma que las ratas sedentárias.

Palabras-clave: Ejercicio Físico, Dieta Hiperglicídica y comportamiento glicêmico.

ANÁLISE DO COMPORTAMENTO GLICÊMICO EM RATAS ADULTAS QUANDO SUBMETIDAS A DIETAS COM DIFERENTES CONCENTRAÇOES DE CARBOIDRATOS E TREINAMENTO DE NATAÇÃO

RESUMO

Este estudo objetivou verificar as relações entre consumo de carboidrato simples na dieta e comportamento glicêmico em ratas Wistar submetidas a procedimento de natação. A amostra foi composta de 32 ratas da linhagem Wistar pesando no início do experimento entre 200 e 300 g, sendo 20 animais para o grupo experimental que foi exercitado e 12 animais para o grupo controle que foi mantido sedentário, destes havia um grupo exercitado e um sedentário com dieta hiperglicidica, e um grupo exercitado e um grupo sedentário com dieta normal. A dieta hiperglicidica consistia em adição de 5% de sacarose na água ingerida pelos animais. O treinamento físico utilizado foi o procedimento de natação que era realizado cinco vezes por semana com duração de uma hora. Em relação à variável dependente quantidade de ração/dia consumida, observou-se efeito do exercício físico e da dieta no maior consumo pelas ratas treinadas ou sedentárias sem dieta quando comparadas aos animais treinados ou sedentários com dieta. Observou-se, também, um alto consumo de água carboidratada pelas ratas com dieta, assim como uma diminuição significativa do consumo de carboidratos/dia. Da mesma forma houve uma diferença estatística significativa no que diz respeito ao consumo de carboidratos/dia entre os grupos em relação a variável independente dieta de forma que as ratas sedentárias tiveram maior consumo de sacarose em relação às treinadas. A análise de variância mostra que não houve diferença significativa na glicemia dos grupos, mas mostrou uma tendência a significância ($p = 0,055979$) com relação a variável independente dieta (animais com dieta hiperglicídica x animais sem dieta hiperglicídica). Ou seja, as ratas que receberam a dieta hiperglicídica, sedentárias ou treinadas, mostraram glicemia mais elevada que aquelas que não receberam a dieta.

Palavras Chaves: Exercício Físico, Dieta Hiperglicídica e comportamento glicêmico.