37 - THE GLYCEMIC INDEX ON THE SPORT DRINKS AS FACTOR OF MAINTENANCE OF GLYCEMIA: A NEW PARADIGM

ISABEL DE SOUZA CARVALHO[1,3]; FáBIO DA SILVA RIBEIRO[2,3];
JOSÉ FERNANDES FILHO[4, 5]; ESTéLIO HENRIQUE MARTIN DANTAS[5]
[1]Nutricionist and Mst. in Human Motricity Science - UCB/RJ (BR),
[2]Universitary - UNESA (BR), [3]CBMERJ (BR), [4]EEFD/RJ (BR), CNPq, [5]UCB/RJ (BR)
tenente_isabel@terra.com.br

Introduction

Drinks during exercising have already been called "forbidden fruit"; in the first seventy years of the 20th century, they were seen as useless, harmful to the performance and as a weakness and minor virility sign. As legacy of this time, in spite of endless researches demonstrating that the fluid privation resulted in numerous civil and military deaths throughout the years, this practice still persists in the militarism (MURRAY and UDERMANN, 2003). Actually, the water ingestion is the base of life, and carbohydrate drinks during the exercise improve the performance due to maintenance of the glycemia in the normal levels, saving muscular and hepatic glycogen (ANDRADE, LAITANO and MEYER, 2006; DAVIS et al., 1997; WILMORE and COSTILL, 2001). However, not all sweet drinks can fulfill this need (SIZER and WHITNEY, 2003), as carbohydrates have metabolic differences among themselves, which explanation overwhelms and contradicts the current classification (*simple* and *complex*). Actually, ever since the 70s, it has been recognized that the food rich in carbohydrates produces so much different glycemia answers that they are impossible to be explained by the information about their composition (BURKE, COLLIER and HARGREAVES, 1998).

Traditionally, important and fast changes in the levels of glycemia are attributed to the simple carbohydrates, with an abrupt increase followed by a still more abrupt fall; in the other hand, it is known that the digestion and the absorption of complex carbohydrate foods is a slow process, producing steady and constant glycemia and insulin answers. However, fructose is a simple carbohydrate that is slowly absorbed and some sort of foods that are rich in complex carbohydrate (as rice and potatoes) produce high glycemic replies, similar the one that follows the glucose ingestion (BURKE, COLLIER and HARGREAVES, 1998), that it is a simple carbohydrate.

The glycemic index, therefore, offers another way to classify the carbohydrates; the glycemic index indicates the capacity of a carbohydrate to raise the glycemia at its own digestion and absorption speed. Curiously, the evaluation of the glycemic index does not depend on the classification as simple or complex carbohydrate; the rice amid, for example, that is a complex carbohydrate, is digested and absorbed quickly, possessing a higher glycemic index than the peach, which is rich in simple carbohydrate fructose (McARDLE, 2001).

According to this, aiming the clarification of how different drinks, equal in volume and similar in carbohydrates concentration can affect the glycemia in different ways, this study was made in order to compare the glycemic results got through the carbohydrated drinks ingestion of different glycemic index for Military Firemen of the Lifeguards Group of Rio de Janeiro in an only an exercise session (60-minute race).

Material and methods

Thirty eight Lifeguards of Rio de Janeiro, male, and with ages going from 22 to 40 years-old, were subdivided in groups and instructed to run along the beach and come back in an 1.800 meters race twice, totalizing four stages of 15 minutes (the experiment took 60 minutes). At the end of each stage, each group, apart from the Control Group, received 200 ml from a specific carbohydrated drink, totalizing 800 ml in the end of the test.

The tested drinks were *Carbo Plus*®, *Gatorade*®, *Guaraviton*®, *Orange Juice*, *Coconut Water* and *Homemade Serum*.

In order to get all the drinks to present a carbohydrates concentration between 4 % and 8%, as the literature mentions (ACSM, 1996), reducing the *Guaraviton*® and the *Orange Juice* carbohydrates concentration was needed by diluting them in 50% of water.

And, so that all the drinks restituted sodium, there was the concern to add salt to the experiment drinks that were lack of this. *Gatorade*® does contain this already; the 800 ml offered during all the test contained 360 mg of sodium; therefore, this study aimed the equalization of sodium content in the other types of drink to this amount; *Guaraviton*®, the *Orange Juice*, the *Coconut Water* and the *Homemade Serum* received 1 gram of salt each, which offered 390 mg of sodium; as the 800 ml of *Carbo Plus*® contains 100 mg of sodium already, 750 mg of salt were added to this, with 292 mg of sodium added to preexisting 100 mg, totalizing 392 mg of sodium.

The pre and pos glycemia tests were performed by the use of the glycosimeter *One Touch Ultra*®, from *Johnson & Johnson*®.

Results and discussion

The statistical treatment was based on Inferential Analysis: Shapiro-Wilk Test was used to verify the homogeneity of the sample; paired Student T-Test was used to verify the average of the variable glycemia differences intra-groups that had ingested different carbohydrate drinks before and after the test; The Variance Analysis Test (Anova) was used to verify differences in the averages of the variable glycemia, before and after the test, and between the groups which had ingested different substances. To identify possible differences, the Post-Hoc of Bonferroni Test was used. The study admitted a statistical significance level of $p<0,05$.

In Table 1, the results of Anova Test are shown. As we can see, there were significant differences for the variable glycemia.

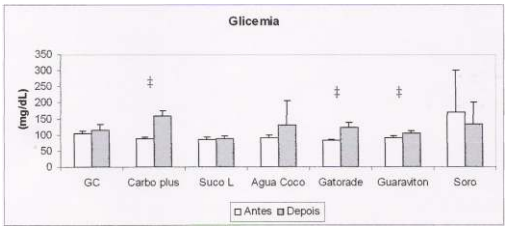
Table 1. Descriptive Results and Homogeneity of the Sample.

Changeable	Squares Addition		Squares Average		F	p -value
Glycemia	Intra	Inter	Intra	Inter		
	119002,00	49749,83	1919,38	3826,90	1,99	0,03

F = Anova; $p<0,05$

The results of the paired Student-T Test for the variable glycemia are displayed in Graph 1. It can be evidenced that the groups that had ingested *Carbo Plus*®, *Gatorade*® and *Guaraviton*® showed significant differences ($p<0,05$) between the compared average values before and after the test.

Graph 1. Glycemia Pay-Test and After-Test.



‡ = significant difference, p<0,05 Juice L = *Orange Juice*
GC = *Control Group* Serum = *Homemade Serum*

In the groups that had ingested *Carbo Plus*®, *Gatorade*® and *Guaraviton*®, the level of glycemia increased significantly after the experiment, from the statistical point of view; however, the glycemia of the groups that had ingested *Orange Juice* and *Coconut Water* remained in normal levels throughout the test, fact that is relevant. The group that had ingested *Homemade Serum* was the only one to present a drop in the glycemia levels after the exercise session.

The question is tough: How can drinks equal in volume and similar carbohydrate and sodium concentrations affect the glycemia after-exercise in different ways? This is probably explained by the fact that there were different types of carbohydrates offered. This study aimed to demonstrate exactly how different carbohydrates affect the glycemic levels, the insulinemia and restore the glycogen storages in different ways during the exercise.

The carbohydrates are not all the same; they keep metabolic differences between themselves which explanation exceeds and contradicts the current classification in *simple* and *complex* (BURKE, COLLIER and HARGREAVES, 1998); simple carbohydrates between themselves, such as glucose and fructose, can show different characteristics and have different physiological effects in the glycemia control (DAVIS et al., 1988; FERNÁNDEZ et al., 2002; MILLARD-STAFORD, 1992). Some sorts of food raise the blood glucose concentrations and insulin liberation more than others, and this influence generates one second form of carbohydrates classification, which is called glycemic index.

In the present study, the glycemia of the group that had ingested *Homemade Serum* was the only one that showed a trend to drop, probably due the fact of that the only source of carbohydrate in this substance is sugar, and sucrose presents “high glycemic index”; so, after its ingestion and quick digestion and absorption processes, the insulinemia increases with the aim of controlling the seric glucose; however, this insulinic rise during exercise promotes immediate glucose consumption, causing a situation called “reactive hipoglycemia” (FERNÁNDEZ et al., 2002; OSTOJIC and MAZIC, 2002).

The glycemia of the group that had ingested *Orange Juice* maintained the normal levels after the exercise, and with a trend to increase, due to the presence of fructose in its composition. Fructose is a “low glycemic index” carbohydrate, and goes through slow digestion and absorption processes, not increasing the insulinemia and the immediate depletion of glucose, thus keeping the energy availability long and constant during exercise (BURKE, COLLIER and HARGREAVES, 1998).

The glycemia of the group that had ingested *Coconut Water* increased 40.38% in average, in regards to the pre-exercise values. However, this increase is not significant from the statistical point of view, because the group standard deviation shoed itself quite large; even tough, this drink was able to keep the glycemia in exercise inside of the normal levels, which was possible due to the presence of fructose in its composition, which, as mentioned previously, is a “low glycemia index” carbohydrate.

The glycemia of the groups that had ingested *Carbo Plus*®, *Gatorade*® and *Guaraviton*® increased significantly because they all have different glycemic index carbohydrates present in their compositions, providing an immediate and long-term energy for the body simultaneously; *Carbo Plus*® is a powder drink diluted in maltodextrin, fructose (“low glycemic index” carbohydrates) and glucose (“high glycemic index” carbohydrate); *Gatorade*® is composed of water, minerals, elements that add color and flavor, and fructose (“low glycemic index” carbohydrate), sucrose and glucose (“high glycemic index” carbohydrates); *Guaraviton*®, on the other hand, is a mixture soft drink made out of roots, fruits and herbs, and contains water, caramel, sucrose (“high glycemic index” carbohydrate), ginseng, guaraná and açaí, which contains fructose (“low glycemic index” carbohydrate) in their composition.

In this research, the glycemia of the *Control Group*, who ingested no carbohydrate, kept itself steady, tending to an increase (about 10.87%); however, in this case, the seric concentration was regulated by glycolise or glyconeogenese (SAAT et al., 2002), because when the muscular glycogen is depleted by the exercise and unable to supply the blood a constant glucose suppliment, hiperglycemiants hormones as the adrenalin, the noradrenalin, the glucagon and the cortisol make the liver metabolize glucose from no-glycidics sources (SOUZA et al., 2003).

Therefore, although the lack of carbohydrates in the exercise, the strong hormonal stimulation can increase the glycemia up to 40, 50% above the rest level, from the glycogenolise and of glyconeogenese (WILMORE and COSTILL, 2001). However, if the experiment of this research exceeded the duration of 60 minutes, the glycemia would probably have dropped, because the mentioned endogenous processes wouldn't be enough to maintain it, and exogenous carbohydrates would become extremely necessary.

Conclusion

All the tested drinks during the exercise, either of industrialized or hand-made origin, apart from the *Homemade Serum*, showed themselves able to keep the glycemia in the normal levels. What differed them from the *Homemade Serum* was the glycemic index of its constituent carbohydrates; they concomitantly presented carbohydrates of high (glucose, sacarose) and low (fructose, maltodextrin) glycemic index, which are digested and absorbed slowly, while the *Homemade Serum* presented only sucrose, which high glycemic index raises the insulinemia at abruptedly and provides reactive hipoglycemia.

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Rua Otacílio Novais, 220/102, Taquara/Jpa.
CEP 22710-020 - Rio de Janeiro/RJ - Brasil
E-mail: tenente_isabel@terra.com.br
Tel.: (21)7820.2400

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ABSTRACT

The carbohydrate drinks ingestion during the exercise improves the performance due to maintenance of the glycemia in the normal levels, saving the muscular and hepatic glycogen. According to this, the present study aimed to compare the effect of the carbohydrate drinks ingestion of different glycemic index in the maintenance of the glycemia in a military group in only an exercise session. Thirty eight Lifeguards of Rio de Janeiro were instructed to run along the beach for 60 minutes, each group having 200 ml of a specific carbohydrated drink every 15 minutes. Straight after the test, the glycemia was checked. The tested drinks that simultaneously present carbohydrates of high and low glycemic index were *Carbo Plus*®, *Gatorade*®, *Açaí Guaraviton diluted by 50%*®, *Orange Juice diluted by 50%* and *Coconut Water*; the drink that presents exclusively carbohydrate of high glycemic index is the *Homemade Serum*. All the tested drinks, apart from the *Homemade Serum*, showed themselves able to keep the glycemia in the normal levels. What differed them from the *Homemade Serum* was the glycemic index of their carbohydrates: They had high glycemic index carbohydrate (glucose, sugar) and low glycemia index (fructose, maltodextrin) in their composition, which are digested and absorbed slowly, while the *Homemade Serum* presented only sugar, which high glycemic index raises the insulinemia abruptedly and provides reactive hipoglycemia. KEY WORDS: Glycemic index, sport drinks, glycemia.

L'INDICE GLYCÉMIQUE DES BOISSONS SUR LE SPORT EN TANT QUE FACTEUR DE MAINTIEN DE LA GLYCÉMIE: UN NOUVEAU PARADIGME

RéSUMé

L'ingestion de glucides des boissons au cours de l'exercice améliore les performances grâce à la maintenance de la glycémie à la normale, en enregistrant le glycogène musculaire et hépatique. D'après ce texte, la présente étude vise à comparer les effets de l'ingestion de glucides des boissons différentes indice de glycémie dans le domaine du maintien de la glycémie dans un groupe militaire en une seule session d'exercice. Trente-huit sauveteurs de Rio de Janeiro ont reçu l'ordre de courir le long de la plage de 60 minutes, chaque groupe ayant 200 ml d'une boisson carbohydrated toutes les 15 minutes. Directement après l'essai, la glycémie a été vérifiée. Les boissons testées simultanément présentes que les hydrates de carbone de haute et de faible index glycémique ont été *Carbo Plus*®, *Gatorade*®, *Açaí Guaraviton dilué par 50%*®, *Jus D'Orange dilué par 50%* et *L'Eau de Coco*; La boisson qui présente exclusivement des hydrates de carbone de haute indice de glycémie est *Sérum Gardien*. Toutes les boissons testées, en dehors de *Sérum Gardien*, se montraient capables de maintenir la glycémie à la normale. Que différente de la leur maison a été la glycémie sérique indice de leurs hydrates de carbone: Ils avaient l'index glycémique élevé de glucides (glucose, de sucre) et un faible indice de glycémie (le fructose, maltodextrine) dans leur composition, qui sont digérés et absorbés lentement, tandis que *Sérum Gardien* Présente seulement le sucre, l'indice glycémique élevé qui soulève la abruptedly insulinémie et fournit hipoglycemia réactive. MOTS CLÉS: L'index glycémique, le sport boissons, la glycémie.

EL ÍNDICE GLUCÉMICO EN LAS BEBIDAS DEL DEPORTE COMO FACTOR DEL MANTENIMIENTO DE GLUCEMIA: UN NUEVO PARADIGMA

RESUMO

La ingestión de las bebidas con carbohidratos durante el ejercicio mejora el funcionamiento debido al mantenimiento del glucemia en los niveles normales, ahorrando el glicógeno muscular y hepático. Según esto, el actual estudio apuntó comparar el efecto de la ingestión de las bebidas con carbohidratos de diversos índices glucémicos en el mantenimiento del glucemia en un grupo militar en solamente una sesión del ejercicio. Mandaron a treinta ocho salvavidas de Río de Janeiro para funcionar a lo largo de la playa por 60 minutos, cada grupo que tenía 200 ml de una específica bebida com carbohydratos cada 15 minutos. Derecho después de la prueba, la glucemia fue comprobada. Las bebidas probadas que simultáneamente los actuales carbohidratos del índice glucémico alto y bajo eran *Carbo Plus*®, *Gatorade*®, *Açaí Guaraviton diluyeron por 50%*®, el *Jugo Anaranjado diluido por el 50%* y el *Agua del Coco*; la bebida que presenta exclusivamente el carbohidrato con alto índice glucémico es el *Suero Hecho en Casa*. Todas las bebidas probadas, aparte de el *Suero Hecho en Casa*, se demostraron capaces de mantener la glucemia los niveles normales. Qué diferenció ellas del *Suero Hecho en Casa* era el índice glucémico de sus carbohidratos: Tenían el carbohidrato com alto índice glucémico (glucosa, azúcar) e bajo índice glucémico (fructosa, maltodextrin) en su composición, que se digieren y se absorben lentamente, mientras que el *Suero Hecho en Casa* presentó solamente el azúcar, que el alto índice glucémico levanta la insulinemia rápidamente y proporciona hipoglicemia reactiva. PALABRAS CLAVE: Índice glucémico, bebidas deportivas, glucemia.

O ÍNDICE GLICÊMICO NAS BEBIDAS ESPORTIVAS COMO FATOR DE MANUTENÇÃO DA GLICEMIA: UM NOVO PARADIGMA

RESUMO

A ingestão de bebidas carboidratadas durante o exercício melhora o desempenho devido à manutenção da glicemia nos níveis normais, poupando o glicogênio muscular e hepático. Neste sentido, o presente estudo buscou comparar os efeitos da ingestão de bebidas carboidratadas de diferentes índices glicêmicos na manutenção da glicemia em militares em uma sessão única de exercício. Trinta e oito Guarda-Vidas do Rio de Janeiro foram orientados a correr pela praia durante 60 minutos, recebendo cada grupo a cada 15 minutos 200 ml de uma bebida carboidratada específica. A glicemia foi verificada imediatamente após o teste. As bebidas que apresentam simultaneamente carboidratos de alto e baixo indice glicêmico testadas foram *Carbo Plus*®, *Gatorade*®, *Guaraviton de Açaí Diluído a 50%*®, *Suco de Laranja Diluído a 50%* e *Água de Coco*; a bebida que apresenta exclusivamente carboidrato de alto índice glicêmico testada foi o *Soro Caseiro*. Todas as bebidas testadas, com exceção do *Soro Caseiro*, mostraram-se capazes de manter a glicemia nos níveis normais. O que as diferia do *Soro Caseiro* era o índice glicêmico dos seus carboidratos: Mesclavam carboidratos de alto (glicose, sacarose) e baixo (frutose, maltodextrina) índice glicêmico, os quais são digeridos e absorvidos lentamente, enquanto o *Soro Caseiro* apresentava apenas sacarose, cujo alto índice glicêmico eleva a insulinemia de forma abrupta e proporciona hipoglicemia de rebote.
PALAVRAS-CHAVE: Índice glicêmico, bebidas esportivas, glicemia.