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BABASSU MESOCARP (ORBIGNYA PHARELATA MART.) SUPPLEMENTATION DECREASED MARKERS OF MUSCLE DAMAGE, PAIN, AND PERCEIVED EXERTION IN TRAINED YOUNG FUTSAL ATHLETES

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ABSTRACT

Introduction and objective: This study aimed to evaluate the efficacy of babassu mesocarp flour (Orbignya pharelata Mart.) supplementation on muscle damage, pain, and effort perception in futsal athletes. Materials and methods: This is a randomized, single-blind, placebo-controlled trial. Ten recreational futsal athletes consumed water, maltodextrin, and babassu mesocarp flour supplement in three different occasions before the training protocol. There was a 5-day washout period between sessions. Afterwards, they underwent a plyometric training session and the futsal-specific intermittent shuttle protocol test (FISP). Blood samples were collected for creatine kinase (CK) analysis. Results: There was a significant increase in CK levels after the babassu supplementation of 11.25% (p=0.02, d=0.26), whereas the Maltodextrin had a non-significant increase of 29% (p=0.08). The reported muscle soreness was smaller after the ingestion of babassu for the jump and FISP tests (p=0.03 e p=0.01, respectively) compared to water intake. No significant difference was found between Babassu and Maltodextrin intake regarding muscle soreness. Conclusion: Babassu mesocarp flour supplementation reduced biomarkers of muscle damage and effort perceptions. However, there was a greater decrease in CK levels after maltodextrin intake compared to babassu mesocarp flour supplementation.

Key words: Athletes. Oxidative stress. Malondialdehyde. Physical functional performance.

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RESUMO

A suplementação do mesocarpo de babassu (orbignya pharelata mart.) Diminui os marcadores de dano muscular, dor e percepção de esforço em jovens atletas de futsal treinados

Introdução e objetivo: Este estudo teve como objetivo avaliar a eficácia da suplementação com farinha de mesocarpo de babaçu (Orbignya pharelata Mart.) no dano muscular, dor e percepção de esforço em atletas de futsal. Materiais e métodos: Este é um estudo randomizado, simples-cego, controlado por placebo. Dez atletas recreativos de futsal consumiram água, maltodextrina e suplemento de farinha de mesocarpo de babaçu em três ocasiões diferentes antes do protocolo de treinamento. Houve um período de washout de 5 dias entre as sessões. Em seguida, eles foram submetidos a uma sessão de treinamento pliométrico e ao teste de resistência específica intermitente de futsal (TREIF). Amostras de sangue foram coletadas para análise de creatina quinase (CK). Resultados: Houve aumento significativo dos níveis de CK após a suplementação de babaçu de 11,25% (p=0,02, d=0,26), enquanto a Maltodextrina teve aumento não significativo de 29% (p=0,08). A dor muscular relatada foi menor após a ingestão de babaçu para os testes de salto e TREIF (p=0,03 e p=0,01, respectivamente) em relação à ingestão de água. Não foi encontrada diferença significativa entre a ingestão de Babaçu e Maltodextrina considerando a dor muscular. Conclusão: A suplementação com farinha de mesocarpo de babaçu reduziu biomarcadores de dano muscular e percepção de esforço. No entanto, houve maior diminuição dos níveis de CK após a ingestão de maltodextrina em comparação com a suplementação com farinha de mesocarpo de babaçu.

Palavras-chave: Atletas. Estresse oxidativo. Malondialdeído. Desempenho físico funcional.

INTRODUCTION

Babassu coconut, a widespread plant in the region of Brazil, contains high levels of carbohydrates, fiber, vitamins, polyphenols, and minerals, including calcium, phosphorus, magnesium, potassium, and iron (Vinhal et al., 2014).

The flour made of babassu mesocarp is highly energetic and contains anti-inflammatory, analgesic, and therapeutic properties (Barroqueiro et al., 2011).

Babassu mesocarp has become an alternative to decrease the physiological damage caused by heavy training loads and optimize recovery (Carrazza et al., 2012; Fonseca, 2014; Moura et al., 2020; Silva, 2011).

Despite the elevated levels of starch, babassu mesocarp, a by-product of babassu oil extraction, has only been used as animal food and biomass (Maniglia and Tapia-Blácido, 2016).

Babassu mesocarp possesses anti-inflammatory, immunomodulatory, analgesic, and antipyretic properties (Azevedo et al., 2007). Although babassu is widely studied in the clinic field, its use in sports performance is still little explored.

Carbohydrate is the most important energetic source in high-intensity exercises and is mostly derived from the glycogen storage. Muscular and blood glycogen is the main energy source in high-intensity exercise sessions, and low carbohydrate levels can lead to muscular fatigue and performance decrease (Cermak and van Loon, 2013).

Carbohydrate intake is an effective nutritional strategy to avoid nutritional deficiency, improve performance, and accelerate recovery (Achten and Jeukendrup, 2003; Hawley and Leckey, 2015; Thomas et al., 2016).

Nutritional supplements are widely used among top-level athletes, including futsal players (Pedrinelli et al., 2015).

However, they do not contain the physical-chemical and antioxidant nature of the babassu.

Therefore, it is important to investigate the viability of the babassu mesocarp flour as a natural nutritional supplement. We hypothesize that the ingestion of babassu mesocarp flour will have an anti-inflammatory and/or ergogenic response.

Thus, this study aimed to evaluate the efficacy of babassu mesocarp flour supplementation on muscle recovery, perception of effort, and muscle damage in futsal athletes.

MATERIALS AND METHODS

Subjects

This is a single-blind, cross-over, placebo-controlled trial. 35 recreational futsal athletes volunteered for this investigation.

Over the course of the study, 25 subjects failed to provide complete data and were excluded. Therefore, 10 subjects participated in the study (25.4 ± 4.9 years). They trained for at least 2 years with three futsal training sessions a week (90-120 min/day), two resistance training sessions (40-60 min/day) and had been training for over three uninterrupted weeks.

None of the participants presented chronic diseases, hypertension, muscle or joint injury and did not use any anti-hypertension medicines.

They were asked to refrain from ingesting nutritional supplement, babassu-derived foods, and alcohol.

They were requested to maintain their regular diet and training programs during the study. This investigation was approved by the ethics committee of the Universidade Federal do Piauí, Brazil, protocol 3,152,352. All participants signed the consent form according to resolution 466/12 and 510/16 of the National Health Council.

Physical and nutritional evaluations

The volunteers were anthropometrically evaluated (body mass, height, body fat). Food record was conducted through a 24-hour food recall, analyzing two different weekdays and one day of the weekend.

Their data were compared to those of the guidelines standardized by the Dietary Reference Intake (DRI) (Institute of Medicine, 2005). Data was analyzed using the software Dietbox® online version.

Experimental protocol

This study consisted of three phases of evaluation, and it was divided into two stages: pre-test and post-test with and without supplementation. The participants consumed water (WG), maltodextrin (MG), and babassu supplement (BG) before the training protocol, each in a different occasion. There was a 5-day washout period between each session to eliminate residual effects.

They were asked to refrain from exercises 48 hours and food intake 4 hours prior to the tests. They consumed a standardized pre-test meal on the no-supplementation stage of the trials (water).

The meal consisted of two loaves of bread, one slice of cheese, and one glass of orange juice (180ml) (9.47g protein, 42+97g carbohydrate, 4.62g lipids, 189 kcal, and water ad libitum). There was a 30min period between the meal and the start of the tests. On the second and third stages of study, there was no pre-test meal. The volunteers consumed only the supplements of the stage (babassu mesocarp flour and maltodextrin).

Training protocol

The participants performed 13 jumps (horizontal and vertical jumps, cyclic and acyclic, using left, right, and both legs) (de Freitas et al., 2017) in order to simulate a legit futsal training session. For the acyclic jumps, they were instructed to jump as high as possible (vertical) or as long as possible (horizontal), while during the cyclic jumps, they were instructed to optimize as much as possible the height/distance ratio and time of contact on the ground.

The order of the exercises was randomized in each session. All jump sessions lasted around 20 minutes and were performed after a 5-minute moderate warm-up session. There was a 60s recovery time between each cyclic jump series and <5s for the acyclic jumps.

After four days, players performed the futsal-specific intermittent shuttle protocol (FISP) to simulate the physiological demands of a full-duration futsal match. The protocol consists of a 4 x 6 min blocks of intermittent exercise with a 5-min passive recovery time between blocks. Each block consisted of six sequences of 10 x 15 m runs at different speeds. The speed was regulated with audio tones. There was a voice command indicating the type of activity before each tone. Participants rested in the seated position on a bench during the 5-min passive recovery period (Freitas et al., 2017).

The Borg Rating of Perceived Exertion scale was used to evaluate the individual's effort and exertion. The values range from 0 (at rest) to 10 (exhaust) (Borg, 1982).

Blood analysis

Plasma creatine kinase (CK) was obtained as an indicator of muscle damage. Blood samples (10mL) were collected from the participants before and 24 hours after the last exercise session by a trained and qualified professional.

The volunteers were asked to refrain from food intake (4 hours) and any physical activity (48 hours) before the blood collection. Blood samples were centrifuged at 2500rpm for 15 minutes. Serum and plasma were transferred to microtubes and refrigerated at <-20º for analysis.

Muscle damage

Delayed Onset Muscle Soreness was self-reported using the Visual Analogue Scale and Visual Numeric Scale (Mizumura and Taguchi, 2016), ranging from 0 to 10. They performed a semi-squat and then inform the muscle soreness classification (Alfonsin et al., 2019).

Statistical Analysis

Normality and homogeneity of the data was evaluated through Shapiro-Wilk's and Levene's tests, respectively. Between groups comparison was made via One-way ANOVA with repeated followed by Bonferroni's post-hoc test. Effect size (Cohen's d) was calculated, considering 0–0.19, 0.20–0.49, 0.50–0.79, and 0.80 as trivial, small, moderate, and large, respectively (Cohen, 1988). The statistical analysis was made using the software SPSS version 21.0 and the significance value was established at $p < 0.05$.

RESULTS

Percentage and weight of the macronutrients and the guidelines according to the Brazilian Society of Sports Medicine are presented in Table 1.

Table 1 - Anthropometric and nutritional data of the participants.

Variable	n=10	BSSM	Minimum	Maximum
Anthropometric data				
Age (years)	25.4 ± 4.9	-	18	38
Height (cm)	175.3 ± 4.5	-	165	184
Weight (kg)	72.16 ± 7.17	-	55.8	85.4
BF (%)	15.04 ± 3.23	-	7.2	22
Nutritional and energy data				
TEE	2125.05 ± 241.48	-	1758	2572
TEV	2689.5 ± 927.81	-	1536	4957
TEV (kcal/kg)	39.08 ± 18.92	-	21.87	88.84
CHO (%)	44.6 ± 8.97	60	25	61
CHO (kcal/kg)	4.34 ± 2.15	5- 8	1.44	9.81
PT (%)	23.6 ± 10.04	15%	13	48
PT (kcal/kg)	2.09 ± 0.80	1.4 – 1.7	1.12	3.65
LI (%)	32 ± 7.68	25	21	46
LI (g)	1.47 ± 0.95	1	0.62	3.87
Training/week	2.9 ± 0.7	-	2	5

Legend: Data are presented as mean and standard deviation of the mean. Abbreviations: TEE, total energy expenditure; TEV, total energy value; BF, body fat; CHO, carbohydrate; PT, protein; LI, lipid; BSSM, Brazilian Society of Sports Medicine.

The volunteers' diet exceeded their energy necessities and did not meet the minimal demands of carbohydrates (TEE=2125.05 ± 241.48, TEV=2689.5 ± 927.81). Moreover, it was observed an inadequate distribution of macronutrients.

There was no significant difference in baseline plasma CK levels between treatments. Babassu intake caused gastric distress in only one athlete (F > 0.20).

Training session caused a significant muscular damage increase in CK levels (42%) at 24h post-exercise in the Water Group (Table 2). Similarly, the Maltodextrin group also had an increase in CK in 29%, although not significant (p=0.08, d=0.55). However, there was a significant increase in CK levels after the babassu supplementation of 11.25% (p=0.02, d=0.26)

The report of muscle soreness was smaller after the ingestion of babassu for the jump and FISP tests (p=0.03 e p=0.01, respectively), compared to water intake. There were no statistical differences in the rate of perceived exertion between WG and MG in any of the training sessions, as well as when comparing BG and MG (Table 2).

Table 2 - CK concentration, rate of perceived exertion, and muscle soreness scale before and after FISP test.

<table>
<tr><td colspan="7">CK (d = 0.40)</td></tr>
<tr><td></td><td colspan="2">Pre-test</td><td colspan="2">Post-test</td><td colspan="2">p</td></tr>
<tr><td>Water</td><td colspan="2">294.3 ± 222.25</td><td colspan="2">512.9 ± 406.39</td><td colspan="2">0.02*</td></tr>
<tr><td>Maltodextrin</td><td colspan="2">329.4 ± 199.87</td><td colspan="2">411.9 ± 249.36</td><td colspan="2">0.08</td></tr>
<tr><td>Babassu mesocarp</td><td colspan="2">315.4 ± 254.88</td><td colspan="2">355.4 ± 228.45</td><td colspan="2">0.02*</td></tr>
<tr><td colspan="7">Rating of perceived exertion (d = 0.49)</td></tr>
<tr><td></td><td colspan="2">Post-test</td><td colspan="2">Post-test 24h</td><td colspan="2">Post-test 48h</td></tr>
<tr><td>Water</td><td colspan="2">7.8 ± 0.7</td><td colspan="2">7.5 ± 0.7</td><td colspan="2">7.4 ± 0.8</td></tr>
<tr><td>Maltodextrin</td><td colspan="2">7.0 ± 0.6</td><td colspan="2">6.7 ± 0.6</td><td colspan="2">5.3 ± 0.6</td></tr>
<tr><td>Babassu mesocarp</td><td colspan="2">6.1 ± 0.4 #</td><td colspan="2">4.8 ± 0.4 #</td><td colspan="2">5.5 ± 0.5</td></tr>
<tr><td>p</td><td colspan="2">0.03#</td><td colspan="2">0.01#</td><td colspan="2">0.89</td></tr>
<tr><td colspan="7">Muscle soreness</td></tr>
<tr><td></td><td colspan="2">Post-test 24 h</td><td colspan="2">Post-test 48h</td><td colspan="2">Post-test 72h</td></tr>
<tr><td>Water</td><td colspan="2">4.2 ± 3.1 5.0 (8.0)</td><td colspan="2">4.8 ± 3.0 5.5 (8.0)</td><td colspan="2">4.1 ± 2.4 4.5 (8.0)</td></tr>
<tr><td>Maltodextrin</td><td colspan="2">2.5 ± 2.4 2.0 (7.0)</td><td colspan="2">1.4 ± 1.5 2.3 (5.0) #</td><td colspan="2">1.9 ± 2.4 1.0 (6.0) #</td></tr>
<tr><td>Babassu mesocarp</td><td colspan="2">2.4 ± 2.8 1.0 (7.0)</td><td colspan="2">1.2 ± 1.8 1.5 (7.0) #</td><td colspan="2">2.0 ± 2.2 0.0 (5.0)</td></tr>
<tr><td>p < 1 p /2 and 1 p/ 3</td><td>0.28</td><td>1.0</td><td>0.01</td><td>0.01</td><td>0.04</td><td>0.28</td></tr>
</table>

Legend: Abbreviations: CK. creatine kinase; * significant difference between groups; # Significant difference for the negative control (p=0.05); d. effect size; 1. Water; 2. Maltodextrin; 3. Babassu mesocarp.

Muscle soreness report indicated that the fatigue report was significantly smaller on the second day after maltodextrin and babassu ingestion.

The participants reported more soreness after water and babassu intake 24 hours after the third session (Table 2).

Maltodextrin and babassu mesocarp nutritional characteristics are presented in Table 3

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Table 3 - Maltodextrin and babassu mesocarp nutritional data.

Macro and micronutrients	Maltodextrin (mg)	Babassu mesocarp (mg)
Total kcal/100g	400	328.77
Carbohydrate	100	79.19
Protein	0	1.41
Lipid	0	0.2
Calcium	0	60.95
Iron	0	18.33
Dietary fiber	0	17.86
Phosphorus	0	25.56
Magnesium	0	39.35
Manganese	0	0.38
Potassium	0	362.07
Sodium	60	12.46
Vitamin B3 (Niacin)	0	2.58
Zinc	0	0.34
Total phenolic compounds	0	558.87

DISCUSSION

The main findings of this study were that babassu mesocarp flour ingestion improved muscle soreness and effort perceptions in futsal recreational players after one supplementation dosage before the training tests.

Furthermore, babassu mesocarp supplement caused a decrease in CK levels, although it was smaller than that of the maltodextrin supplement. We hypothesize that the anti-inflammatory nature of babassu mesocarp played an important role in these results.

A study investigated the anti-inflammatory and healing capacity of babassu mesocarp and found corroborative results of these effects (Batista et al., 2006).

Babassu mesocarp is widely consumed by the native Brazilian community for its medicinal properties as a resource for the treatment of inflammatory and infectious diseases (Souza et al., 2011).

A study evaluated the quantification of tannins in babassu mesocarp and classified it as a functional, herbal and pharmaceutical food (Farias et al., 2019).

In our study, participants had lower muscle soreness perception after babassu ingestion than water in the first and second training session. Maltodextrin caused lower muscle soreness perception than water in the second and third training sessions.

The glycemic index plays a huge role in physical performance since it is related to the lipidic oxidation. The moment of carbohydrate ingestion before the exercise is a key factor in physical performance (30-60 min before the physical activity).

A proper carbohydrate ingestion prevents hyperinsulinemia, which can affect the usage of muscle glycogen during the first stage of the exercise, impairing the performance (Cecato et al., 2010; Cocate et al., 2009). The protector effect of maltodextrin is probably due to its high glycemic index, which is significantly higher than that of the babassu mesocarp.

The ingestion of high-carbohydrate food before the exercise affects the hepatic and muscular glycogen levels (Gouveia and Passanha, 2011).

Since futsal training sessions are long and frequent, the proper ingestion of carbohydrate plays a huge role in recovery and muscular performance (Hernandes, 2000).

However, low glycemic index foods provide greater increase in the physical performance in exhausting sessions than high glycemic index foods (Junior and Carvalho, 2018). Thus, the consumption of babassu mesocarp during the training session is not interesting as its fibers delays the gastric emptying process.

Noteworthily, CK levels before the tests were statistically similar on the first day of each test. Babassu mesocarp intake caused gastric distress in only one athlete.

There was a decrease in CK levels for the Maltodextrin and Babassu groups. However, the decrease was greater for the MG, compare to the others, providing a greater protector effect on muscle damage.

The food intake record of the present investigation demonstrated inadequate carbohydrate intake. Thus, babassu mesocarp flour supplement could contribute to improve this deficiency, as well as help replenish the storage of fibers, vitamins, and minerals, such as calcium, iron, phosphorus, magnesium, manganese, potassium, sodium, vitamin B3 (niacin), and zinc.

Moreover, babassu consists of total phenolic compounds, proving to be superior than maltodextrin, composed basically only of carbohydrate (Ataíde e Silva et al., 2014; Carrazza et al., 2012; Silva, 2011).

CONCLUSIONS

The participants of this study did not present the recommended dietary ingestion of macronutrients. Babassu mesocarp flour supplementation can be used as a nutritional strategy to improve the muscle soreness perception in futsal athletes.

The ingestion of babassu mesocarp flour had a positive effect on muscle soreness and sensation of pain related to the training sessions.

The lack of effect on CK needs to be better investigated through studies with chronic administration and higher doses of babassu supplement, which can potentiate its ergogenic properties and enhance the recovery.

It is worth mentioning that some variables were not assessed in this investigation, such as inflammatory markers and antioxidant enzymes.

Further studies should investigate the effect of chronic administration of babassu supplementation on inflammation, oxidative stress, muscle tissue repair, athletic performance, and the ergogenic effect in both continuous and intermittent sports.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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