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Impact of an enriched pregame meal on athletic performance

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Abstract
Background: A "Soy Protein Isolate enriched Pregame Chocolate Bar" (SPIPCB) developed was evaluated for its acceptability, nutrient content, keeping quality and its effect on selected male athletes.
Materials and Methods: 100 g of the soy protein enriched bar was administered to the athletes as a pregame meal. 75 sprinters were selected from the District Sports Hostel, Tirunelveli and were equally distributed into 3 groups of 25 each. The first group (Group I) was used to study on a cross sectional basis. All of them were subjected to performance assessment before (on empty stomach) and after they were given the two pregame meals. Bread and Jam (UPGM) was chosen as the pregame meal for comparison purpose. Subsequently after an interval of seven days, the enriched SPIPCB-I was given once on a chosen day. After an interval of 7 days the SPIPCB -7 was given for 7 consecutive days and performance evaluated on the seventh day. The second (UGPM- Group II) and third (SPIPCB -Group III) groups of 25 each were also subjected to impact evaluation. It was a onetime provision and performance was assessed using physical work capacity (Harvard Step Test), Endurance Test (Tread mill Test), Athletic event test (100 m sprint).
Results: The SPIPCB developed provided about 418 kcal and it kept well for 3 months the impact of the bar on athletic performance revealed that it enhanced both physical work capacity and biochemical parameters studied.
Conclusion: Seven day administration was more beneficial suggesting that regular use of SPIPCB as a pre-event meal would certainly provide the winning edge for the athlete in the long run.

Keywords: pregame meal, athletic performance, soy protein isolate, athlete, endurance.

1. Introduction

Good performance requires knowledge to interweave many factors such as athletic training, genetic makeup and good nutrition. Good nutrition is one of the most important factors but ids less frequently understood. According to Clark, Nancy, MS, RD (2008) victory does not go to those who flee quickly but to those able to persevere in confrontation. It is good nutrition that certainly makes the difference for the last split second, the last 2.5 cms or the late game super effort in performance (William, 1983). Long term good nutrition can enhance or maximize an athlete's potential but a poor diet can certainly harm performance (Journal of American Dietetic Association, 1993).
Many experts believe that the type of food athletes eat before a competition influences their performance. An ideal pregame meal should be light, low in fat and protein high in complex carbohydrates and eaten two to three hours before competition. This allows the body to digest absorb and transform the carbohydrate into stored glycogen while minimizing any digestion, hunger and gastric distress during competition. A pregame meal should provide 300 to 800 kcal of energy with 60 -70 percent of the total energy coming from carbohydrate, 10 – 15 percent from the protein and the rest coming from fat.
A number of pregame meal products have been prescribed by the coaches and trainers for pre-event consumption. Though sports bars look and often tastes like candy bars, they are lower in fat, provide more fiber and contain vitamin C, vitamin E, Calcium, iron, magnesium, copper and zinc and a host of B vitamins (Puhl and Buskirk, 1998). The greatest advantage of sports bars is convenience. They are proportioned, ready –to-eat and transportable.
Considering the popularity and convenience of sports bar the current study was undertaken to develop a pregame chocolate bar, which could provide sustained energy to the athlete, consisting of high complex carbohydrates, optimal fat and protein levels and evaluate its impact on male athletes.

Materials and Methods

Development of SPI enriched pregame chocolate bar.

Because of the wide popularity and the ease with which they can be administered just before the event, this chocolate bar was developed to provide sustained energy for athletes, using food materials of common usage and availability .The raw ingredients include malted wheat flour, soy flour, milk powder, sugar, glucose, honey butter, vegetable fat, cocoa powder and soy lecithin. Soy protein isolate was added at 13 percent levels since it provides considerable amounts of sustainable energy and individual amino acids of a good quality protein. The energy provided by the 'high energy bar' (SPIPCB) per serving of 100 g was 418 kcal.
The nutrient content of the SPIPCB was appraised using standard procedure outlined by National Institute of Nutrition (1999). The SPIPCB was tested for acceptability on the basis of organoleptic parameters such as appearance, color texture, flavor and taste. Acceptability was tested by administering it to the athletes before the conduct of the study. Shelf life of the chocolate bar was analyzed based on the microbial count,

peroxide value and reducing content of the bar on storage over a period of 3 months.

Identification of athletes and assessment of their daily activities

Two hundred athletes performing different athletic events between the age group of 17 and 19 years were identified from the District Sports hostel, Tirunelveli, Tamilnadu, India. Out of the two hundred athletes 96 athletes were sprinters and 106 were endurance athletes.

Based on their individual athletic performance (ability to complete 100 meters sprint within the stipulated time) 75 sprinters were further selected from the 96 sprinters and equally distributed into three groups of 25 each.

A comprehensive study was conducted to gather information on the food habits, meal pattern and training regimen of the athletes with the help of a pretested and validated questionnaire.

Measurement of physical parameters, energy expenditure and food consumption pattern of athletes

To assess the athletes' physical stature, anthropometric parameters such as height, weight, mid-arm circumference, chest circumference and skinfold thickness were measured using the standard procedures given by Jelliffe (1989).

The energy expenditure pattern was determined on thirty subjects (ten each drawn from the three groups) using time and activity record which involved self-recording of activities by the subjects for 1440 minutes of the day for three days including a weekend. The schedules were collected and the specific activity was coded following the standard procedure adopted by NIN (1999). The energy expenditure was calculated based on the body weight of the individuals. The energy intake and expenditure values were then compared.

The food consumption pattern was assessed on the same subjects through a three day food weighment survey. Weight of the cooked food was calculated for each meal and raw equivalents were calculated using Nutritive value of Indian Foods.

Evaluation on the Impact of SPI enriched pregame meal

The first group of 25 athletes (Group – I) were used to study on a cross sectional basis. All of them were subjected to performance assessment before (on empty stomach) and after they were given the two pregame meals. Based on the preference of athletes, bread and jam (UPGM) was chosen as pregame meal in usage for comparison purposes. Subsequently after an interval of seven days, the enriched pregame bar was given once on a chosen day (SPIPCB -1) and performance evaluated.

After an interval of seven days, the enriched pregame bar was given for seven consecutive days (SPIPCB – 7) and performance evaluated on the seventh day. The second and third groups of 25 each were also subjected to impact evaluation to further establish the possible role of the bar. In this phase of experiment, group II (UPGM; N=25) was given bread and jam as pregame meal whereas group III (SPIPCB N = 25) was given only the pregame game bar. It was a one-time provision and performance assessed through

Physical Work Capacity

a) Harvard Step Test
b) Endurance Test
c) Tread mill test
d) Athletic event test (100 meters sprint)

Results and Discussion

Nutrient Content and Acceptability of the SPI enriched pregame chocolate bar

Table 1: Nutrient content of the SPI enriched pregame chocolate bar

Nutrients (per100g)	SPIPCB (100g)
Protein (g)	11.20
Fat (g)	8.9
Carbohydrates (g)	73.2
Energy (kcal)	418
Calcium (mg)	215
Iron (mg)	3.0
Vitamin A (mcg)	201
Phosphorus (mg)	342.7
Thiamin (mg)	0.45
Riboflavin (mg)	0.3
Niacin (mg)	0.7
Vitamin C (mg)	1.3
Zinc (mg)	0.83

The total calories obtained from SPIPCB were 418 kcal and carbohydrates from SPIPCB supplied 69% of total energy supplied by the bar. Energy supplied by the protein (11%) and fat (20%) were well within the range suggested by Smolin and Grosvenor (2006). SPIPCB also supplied appreciable amounts of micronutrients like vitamin A 201mcg, iron 3mg, phosphorus 342.7 mg, vitamin C 1.3 mg, zinc 0.83 mg and a host of B vitamins- thiamin, riboflavin and niacin (0.45 g, 0.3 g, 0.7 mg respectively). Hence through addition of SPI, enrichment in terms of readily available carbohydrates and micronutrients could be achieved Wu, C.L, *et al*., 2003

Table 2: Mean Acceptability Scores of SPIPCB

Criteria	Freshly Prepared	4 weeks	8 weeks	12 weeks
Appearance	4.1	4.1	4.1	4.0
Color	4.3	4.3	4.3	4.1
Texture	4.4	4.4	4.2	4.0
Flavor	4.4	4.4	4.4	4.4
Taste	4.3	4.3	4.3	4.3
Total	21.5	21.5	21.3	20.8

The total acceptability scores of SPIPCB after 4 weeks of storage at 37 ˚C were similar to the scores of the fresh SPIPCB. After 8 weeks of storage only texture diminished by 0.2 points. Very small changes in appearance (0.1) and texture (0.4) occurred after 12 weeks. Hence SPIPCB had acceptable keeping quality in terms of shelf life for at least three months.

Table 3: Keeping Quality of SPIPCB

S. No	Parameters	Fresh Sample	After 12 weeks	Difference
1	Total Microbial count (cells/g at 37 ˚C)	0.4×10^3	6×10^3	5.6×10^3 *
2	Reducing Sugar(%)	72.32	69.86	2.46
3	Peroxide Value (mEq / kg)	224.61	219.76	4.85 **

* Acceptable upto 50×10^3 (PFA, 1954)

** Standards not available.

The total microbial count showed a marginal increase of 5.6 x 10^3 cells/g. Reduction in sugar content was marginal (2.46 percent). Peroxide value diminished by only 4.85 mEq / kg. Since standards for chocolate bars are not available, comparison of the latter two parameters was made with the values obtained by the fresh sample.

Table: 4: Mean cardiovascular efficiency Scores (CES) of athletes before Step test.

Groups	Description	Mean CES of athletes		Difference	' t ' Value	
		Before administration	After administration		IVF	Between Pregame meals
Group – I	UPGM	52.73 ± 18.67	62.07± 19.04	9.34	1.75 NS	UPGM & SPIPCB-1-0.77 **NS**
(N=25)	SPIPCB-1	52.73 ± 18.67	66.28 ± 19.55	13.55	2.51*	UGPM & SPIPCB-7 -1.12**NS**
(Cross Sectional Basis)	SPIPCB -7	52.73 ± 18.67	68.25 ± 19.97	15.52	2.84*	SPIPCB 1& SPIPCB 7 -0.35**NS**
Group – II	UPGM	64.61± 9.68	68.22 ± 10.88	3.61	1.24 NS	Between Groups
Group - III	SPIPCB	72.16 ± 7.26	76.25 ± 7.16	4.01	2.02**	UPGM & SPIPCB – 0.41 **NS**

* Significant at one percent levels
** Significant at five percent levels.
NS – Not Significant

When athletes in Group I were administered with UPGM increase in cardiovascular endurance was statistically insignificant while administration of SPIPCB once or for seven days obtained more or less similar increase of 13.55 and 15.52 respectively (both significant at one percent level). No significant impact was observed between one time administration and prolonged supplementation for seven days. One time administration of UPGM and SPIPCB on Groups II and III showed that SPIPCB had better significant effect and UPGM did not have any impact on CES. From this it is evident that pregame meals in general have a positive impact on CES of athletes.

Table 5: Mean Recovery Pulse Rate (RPR) of athletes after Harvard Step Test

Groups	Description	Mean RPR of athletes		Difference	' t ' Value	
		Before administration	After administration		IVF	Between Pregame meals
Group - I	UPGM	46.64 ± 4.90	41.84 ± 5.42	4.8	3.29*	UPGM & SPIPCB-1-0.00 **NS**
(N=25)	SPIPCB-1	46.64 ± 4.90	41.84 ± 5.27	4.8	3.33*	UGPM & SPIPCB-7 -1.73**NS**
(Cross Sectional Basis)	SPIPCB -7	46.64 ± 4.90	68.25 ± 5.49	5.92	4.02*	SPIPCB 1& SPIPCB 7 -0.74 **NS**
Group – II	UPGM	46.36 ± 4.14	44.96 ± 4.81	1.4	1.24 NS	Between Groups
Group - III	SPIPCB	42.56 ± 3.59	41.32 ± 23.75	1.24	2.02**	UPGM & SPIPCB – 2.14**

* Significant at one percent levels
** Significant at five percent levels.
NS – Not Significant

Comparison of the impact of the two pregame meals UPGM and SPIPCB administered once or for seven days had no impact on Recovery Pulse Rate.

Table 6: Mean Endurance Capacity of Athletes on a Tread Mill

Groups	Description	Mean Endurance of athletes on a Treadmill (minutes)		Difference	' t ' Value	
		Before administration	After administration		IVF	Between Pregame meals
Group - I	UPGM	34.96 ± 3.24	32.08 ± 3.71	3.12	3.71*	UPGM & SPIPCB-1-4.63*
(N=25)	SPIPCB-1	34.96 ± 3.24	42.68 ± 3.31	7.72	8.33*	UGPM & SPIPCB-7 -5.75*
(Cross Sectional Basis)	SPIPCB -7	34.96 ± 3.24	43.48 ± 2.89	8.52	9.81*	SPIPCB 1& SPIPCB 7 -0.91**NS**
Group – II	UPGM	34.0 ± 3.25	36.96 ± 3.09	2.96	9.60*	Between Groups
Group - III	SPIPCB	33.96 ± 4.04	40.0 ± 3.48	6.04	19.99*	UPGM & SPIPCB – 3.27*

* Significant at one percent levels
** Significant at five percent levels.
NS – Not Significant

Athletes in Group I when on SPIPCB once or for seven days could endure treadmill activity twice as long as on UPGM (7.72 minutes and 8.52 minutes) respectively as against only 3.12 minutes when on UPGM. Comparison between the effect of the two pregame meals on Group I athletes revealed that SPIPCB administerd once or for seven days had two fold effect on endurance capacity compared to UPGM.

Comparison of the effect of UPGM on Group II and Group III athletes revealed a threefold increase in endurance capacity (2.96 minutes in Group II against 6.04 minutes in Group III) both significant at one percent levels. The finding adds on to the fact established by Jan drain *et al*., (1984) that pregame meal benefit performance by providing endurance over competing on an empty stomach. The energy supplied by the pregame meal is completely utilized by the body for the activity.

Table 7: Mean Running Time of Athletes (100 m Sprint)

Groups	Description	Mean Running Time of athletes 100 m Sprint (seconds)		Difference	' t ' Value	
		Before administration	After administration		IVF	Between Pregame meals
Group - I	UPGM	12.13 ± 0.35	11.91 ± 0.36	0.22	2.16**	UPGM & SPIPCB-1-1.63 NS
(N=25)	SPIPCB-1	12.13 ± 0.35	11.75 ± 0.34	0.38	3.86*	UGPM & SPIPCB-7 -3.73*
(Cross Sectional Basis)	SPIPCB -7	12.13 ± 0.35	11.54 ± 0.35	0.59	5.95*	SPIPCB 1& SPIPCB 7 -2.18**
Group – II	UPGM	12.0 ± 0.25	11.76 ± 0.20	0.24	3.81*	Between Groups
Group - III	SPIPCB	11.97 ± 0.34	11.70 ± 0.34	0.29	2.75*	UPGM & SPIPCB – 0.572 NS

* Significant at one percent levels
** Significant at five percent levels.
NS – Not Significant

The mean running time (100m sprint) clearly brings out the enhanced effect of pregame meal on performance. In Group I, SPIPCB given once and for seven days helped the athletes to complete the race well ahead by 0.38 seconds and 0.59 seconds respectively (both significant at one percent level). Comparison of the two pregame meals showed that SPIPCB for seven days was more beneficial than one time administration.
Comparison between Group II and Group III showed that SPIPCB shortened running time by 0.05 seconds.

Conclusion

The athletes in the present study met the standards for height, weight, arm circumference and chest circumference. The skinfold thickness of the athletes were less than the standard by 5.5 mm which is probably due to the depletion of fat stores as the body uses fat as fuel to meet the excess energy needs. Based on the preference of majority of athletes (54%) bread and jam was chosen as pregame meal in usage (UPGM) for comparison purposes. SPIPCB developed was rich in carbohydrate, micronutrients like vitamin A, thiamin, riboflavin, niacin, phosphorus, and zinc. Hence through addition of SPI enrichment in terms of readily available carbohydrates and micronutrients could be achieved. Acceptability scores showed that the bar is acceptable and had a shelf life of atleast three months. SPIPCB administered once or for seven days had improved CES better than UPGM. Comparison of the two pregame meals and SPIPCB administered once or for seven days had no effect on recovery Pulse Rate of athletes after Harvard Step Test. SPIPCB had immense effect on prolonging the athletic endurance on a tread mill. Group I athletes on SPIPCB administered once or for seven days could endure treadmill activity twice as long as on UPGM. Comparison of the effect of the two pregame meals on Group II and Group III athletes showed that SPIPCB produced three fold increases in endurance capacity compared to UPGM. SPIPCB given once or for seven days helped the athletes to complete the race well ahead by 0.38 and 0.59 seconds respectively. Comparison between Group II and Group III athletes showed that SPIPCB shortened running time by 0.05 seconds. The impact of the bar on athletic performance revealed that it enhanced physical work capacity and suggests that regular use of SPIPCB as a pre event meal would certainly provide the winning edge for the athlete in the long run.

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