International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Composition of Protein Supplements - A Web Based Survey

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Abstract: ***Background: Protein is one of the most popular dietary supplements marketed to athletes. Protein supplements are promoted to increase muscle mass, prevent protein catabolism and enhance glycogen resynthesis. Methodology: The objective of the study was to explore the composition of protein supplements in terms of protein content, source and cost. All the supplement stores in Vadodara were identified and all protein supplements from their websites were listed. The details of these products were collected from official websites of the respective brands. Products that did not provide Nutrition Facts Panel were excluded. Results: In all, 59 products from 15 brands were surveyed which were in the form of powder (83.05%), bar (13.56%) and beverage (3.39%). The serving sizes varied from 24g to 72g for powders which have to be reconstituted into beverage by adding to milk or water. Serving sizes for bars ranged from 50-80g and for beverages from 414-429ml. Protein content per 100g of product was 80-90g in 11.7%, 70-80g in 30% and 60-70g in 25% of the products. The top protein sources were whey protein concentrate (58.33%), whey protein isolate (50%), milk protein concentrate (23.33%), milk protein isolate (21.66%) and micellar casein (20%). The cost per gram of protein ranged from INR 1.71 to 11.78 for powders and INR 4.95-13.9 for bars. Of the total products, 71.67% contained only sugar, 28.3% only sweetener and 61.6% sugar plus sweetener. Directions for use were not indicated on 20% of the products. Conclusion: The most common source of protein was whey protein concentrate and the protein content of majority of the products ranged from 70-80%.***

Keywords: Protein supplement, Protein bar, Protein beverages, Protein content, Protein sources, sports supplements

1. Introduction

A dietary supplement is a commercially available product that is consumed as an addition to the usual diet and includes vitamins, minerals, herbs, amino acids, and a variety of other products/nutrients. A large number of athletes were demonstrated to be consuming dietary supplements even in the earliest of studies. United States sales of dietary supplements increased from $US 4 billion in 1994 to $US 33 billion in 2012 which is an eightfold increase over 18 years. Moreover, the Global sales of supplements was worth $US 96 billion in 2012 [1]. Dietary supplements are intended to improve sports performance and recovery following exercise in athletic population [2].

With the supplement market being what it is today, supplements are readily available to athletes and are more accepted within the athletic culture [3]. Athletes prefer dietary supplements depending on the nature of the physical activities of the respective sport and the desired outcomes from the product. There is a huge range of sports supplement products and the most popular among them are sports drinks, minerals, caffeine, Protein, Coenzyme Q10, and Creatine [4]. Competitive or elite athletes perform intense and prolonged physical activity frequently and often report that the primary reason for using dietary supplements is to enhance performance or recovery from exercise [1].

Protein is an essential nutrient in the diet and is used to manufacture body proteins that have important structural and functional roles. Endurance athletes in heavy training require extra protein to cover a small proportion of the energy costs of their training and to assist in the repair and recovery process after exercise. Strength athletes, who are interested in gaining muscle size and optimize its function, require more protein in the early stages of very intensive resistance exercise. Adolescent athletes being in the growing phase also have additional protein requirements [5]. Protein supplementation has both been demonstrated to increase strength and lean body mass. Protein intake in combination with resistance training augments gain in fat-free mass [1]. Emerging research looking into milk proteins, whey and casein, points to a role of protein in assisting post exercise fluid retention [6].

The sports supplements market is flooded with Protein supplements. Various sources of Protein of animal and vegetarian origin are utilized in them. Many protein supplements are very expensive primarily due to the amount of marketing that accompanies products and the processing [5]. Despite the diverse composition of available protein supplements, not enough Research has been undertaken to explore the same.

2. Methodology

The objective of the study was to explore the composition of protein supplements available in the Sports Supplement stores. The composition of these products was studied in terms of protein content, source and cost. All (three) the sports supplement stores in the city of Vadodara, Gujarat, India were identified. All protein supplements from the websites of these stores were listed. Further, the detailed composition of these products was accessed from official websites of the respective brands. Products that did not provide Nutrition Facts Panel were excluded from the study.

3. Results and Discussion

In all, 59 products were surveyed for their protein content, the source of protein utilized and the cost of these products. These products belonged to 15 different brands. The products were in the form of Powder, Bar and Beverage. The supplements available in powder form have to be

reconstituted into beverage by adding to milk or water. Most of them recommend one serving to be added to 250-350ml water or milk (if the individual has additional calorie requirements).These products are available in various flavors and pack sizes. The bars are supposed to be consumed one at a time. These are recommended to be taken as snacks in between major meals. Those supplements which are in beverage form are ready to drink formulas. Like the powder forms, beverages are also available in various flavors and pack sizes. The bars and beverages are ready to use therefore have an added advantage over powders. Figure 1 shows the percent distribution of various forms of products.

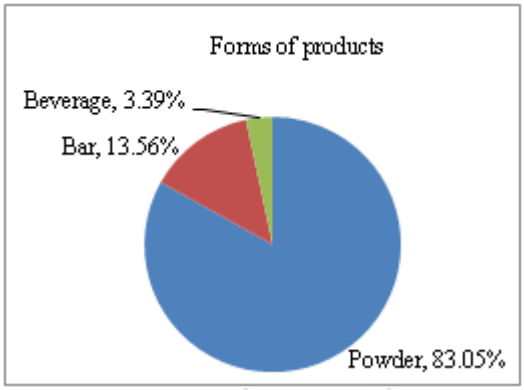

Figure 1: Percent distribution of various forms of Protein supplements

Table 1: Range of Serving size and Cost per gram of protein of all the forms of Products

Variable	*Powder (n=49)*	*Bar (n=8)*	*Beverages (n=2)*
Serving size (g/ml)	24-72	50-80	414-429
Cost per gram of Protein (Rs)	1.71-11.78	4.95-13.9	6.17-7.11

As mentioned in table 1, the serving size of powder form of supplements varied largely. This could be due to the varied protein to carbohydrate ratio across products. As the serving sizes, Protein content and cost per serving vary with products, cost per gram of protein was calculated rather than cost per serving of product. Cost per gram of product also depicted a diverse picture within and between all the forms of products. A study by Moughan (2013) stated that the financial costs of protein products are highly variable, as are the costs of protein-containing foods [7].

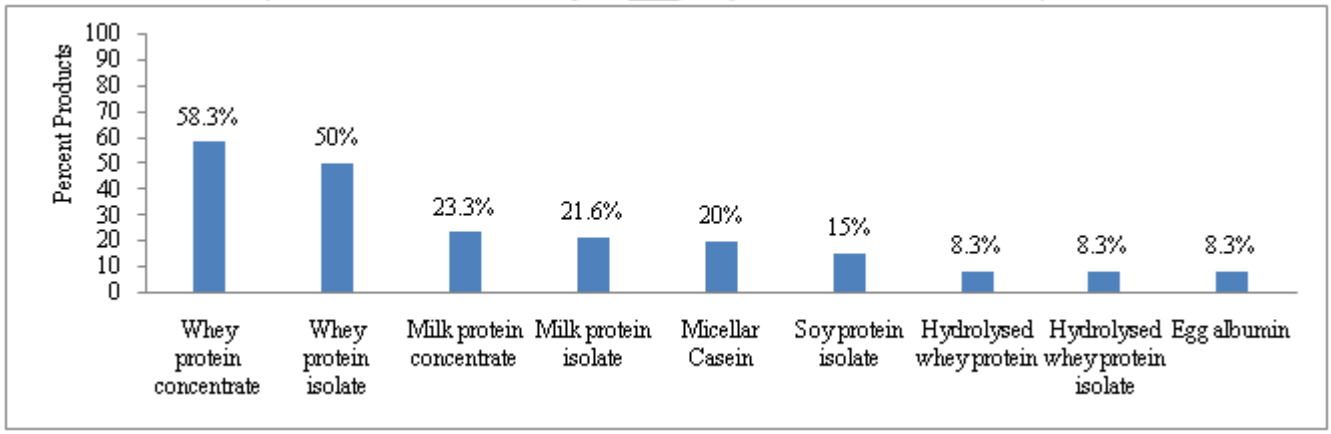

Figure 2: Source of Protein in the Supplements under Study

The top sources of protein depicted in the Figure 2 are discussed here forth. Amongst the top nine sources of protein found in the surveyed products, only one (11.1%) was of vegetarian origin (Soy protein isolate). Seven (77.8%) protein sources were of milk origin and one (11.1%) was egg based. Whey proteins have a strong position in the sports nutrition market based on the purported quality of proteins and amino acids they provide [8]. Whey protein has high amount of essential amino acids, branched chain amino acid, particularly leucine and has rapid digestibility [9]. Whey is the translucent liquid part of milk that remains following the coagulation and curd removal process of cheese manufacturing. From whey, whey proteins are separated and purified using various techniques yielding different concentrations of whey proteins [10]. Whey is one of the two major protein groups of milk, accounting for 20% of the milk protein while casein accounts for the remainder. All of the constituents of whey provide high levels of essential and branched chain amino acids and rapidly elevate plasma amino acids, thus providing foundation for preservation of muscle mass [11]. There are three main forms of whey protein namely whey protein, whey protein concentrate and whey protein isolate. Whey concentrate typically contains more biologically active components and proteins [12]. Whey protein isolates contain protein concentrations of 90% or higher. Processing of whey protein concentrate into whey protein isolate leads to significant removal of fat and lactose. As a result, individuals who are lactose intolerant can often safely consume it. Hydrolyzed whey protein is predigested whey and it typically releases amino acids at a faster rate. The increased bioavailability of hydrolyzed whey further enhances the muscle protein synthesis.

Milk protein concentrates are dairy proteins containing both casein and whey proteins that are available in protein concentrations ranging from 42% to 85% [12]. Although ultra-filtration is the preferred method for producing milk protein concentrates, they can also be produced by precipitating the proteins out of milk or by dry blending the milk proteins with other milk components [13]. Compared to skim milk powder or whole milk powder, milk protein concentrates are higher in protein and lower in lactose. Casein exists in milk in the form of a micelle, which is a large colloidal particle. In athletes supplementing their diets with additional protein, casein has been shown to provide greatest benefit in terms of increase in protein synthesis for prolonged duration [12].

Soyabean can be separated into three distinct categories; flour, concentrates and isolates. Of these three categories, soy flour is the least refined form. While retaining most of the bean's protein, concentrates do not contain as much soluble carbohydrates as flour, making it more palatable. Soy isolates are most refined soy protein containing highest protein content but unlike flour and concentrates, contains no fibre. They are easily digestible. Soy protein isolate contains maximum i.e. 90% protein, followed by soy protein concentrate (70%) and soy protein flour 50%. [12].

Products containing egg albumin as a protein source are low on fat and carbohydrates. Egg protein is of high biological value and as it is digested even slower than casein and results in longer release of amino acids in the blood. In a study carried out by Hida et al (2012), egg white protein supplementation caused a significant increase in resistant muscle strength [14].

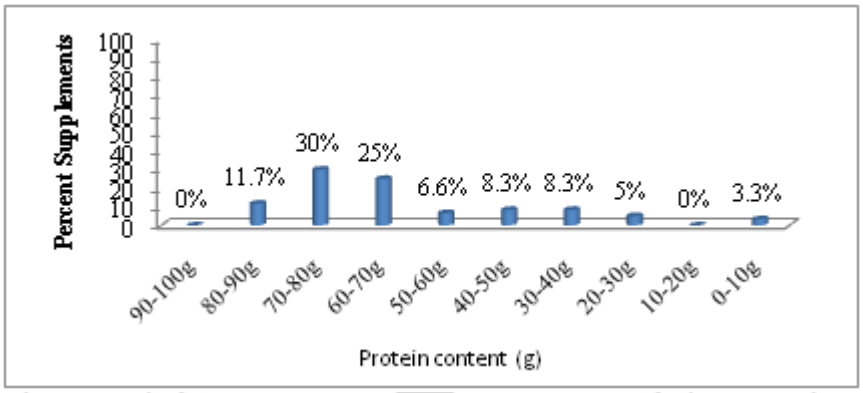

Figure 3: Protein content per 100g of Supplements

Amongst the protein supplements surveyed, the protein content per 100g of supplement varied largely as demonstrated in Figure 3. Maximum i.e. 30% products contained protein in the range of 70-80g. The products in the range of 80-90g protein (11.7%) were all of animal origin. The products containing protein below 10g were beverages. The supplements having protein content between 20 to 30g were bars. The highest protein content was 90g in a powder form product.

Figure 4 illustrates the presence of sweetening agents added to the products. Sweeteners are added in order to reduce the calorie content of the product. Some products had sweeteners as the main sweetening agent plus sugar in very minute quantity. Amongst those products that contained sweeteners, 87% had Sucralose, 15% had Stevia and 43% had Acesulfame Potassium. Sucralose is the only noncaloric sweetener made from sugar and is about 600 times sweeter than sugar. It is minimally absorbed by the body. It is approved by both the Food and Drug Administration and Prevention of Food Adulteration Act. Stevia is a sweetener used as sugar substitute extracted from the leaves of plant species Stevia Rebaudiana and is about 150 times sweeter than sugar. Acesulfame Potassium is a non- calorie sweetener with a clean, quickly perceptible sweet taste. It has good solubility and is 200 times sweeter than sugar. In 2003, it was approved by the United States Food and Drug Administration [15].

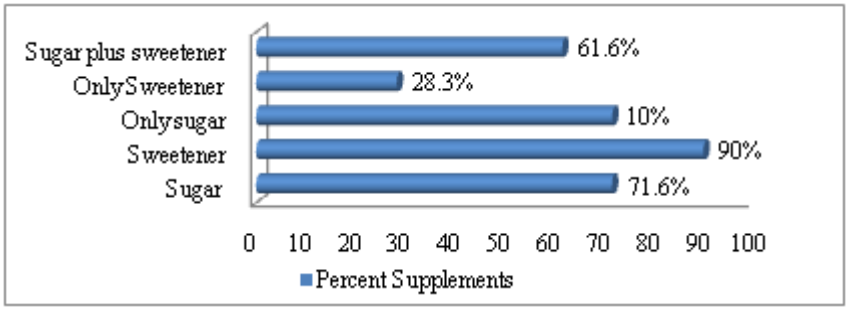

Figure 4: Presence of Sugar/Sweetener in Protein Supplements

Directions for use indicate the way in which the product has to be consumed. The products in powder form were recommended to be added to either water or milk and turned into a shake. Bars and ready to drink beverages carried the

recommended use to be consumed one serving at a time. Directions for use were not indicated on 20% of the products. This may be considered a drawback of the product as the consumers would be forced to consume the supplement in their own different ways.

4. Conclusion

Majority (83.05%) of the surveyed Protein supplements were in the form of powder. The most common source of protein was whey protein concentrate and the protein content of majority of the products ranged from 70-80%. Artificial Sweeteners replaced sugar in 28.3% of products indicating their increasing popularity to target the calorie conscious population. With the products having a wide range of cost per gram of protein and the origin of protein source (plant, animal and egg based) consumers definitely have a broad spectrum of supplements to choose from.

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AURO UNIVERSITY
SURAT, GUJARAT

National Seminar on Anti- Doping, Physical Education, Sports Injuries and Orthopedic Treatments in Sports

Editor :
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Co Editor :
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Graphics & Lay out :
Mr. Naresh Gangwal
+91 98795 75135

ISBN : 978-93-5361-842-1

Published by :

AURO University
Earth Space, Hazira Road,
Opp. ONGC, Surat - 394510, Gujarat, India.

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Performance hydration

There's no one size fits all plan for eating and drinking during exercise but as a general guide:
Sessions or events shorter than 60-90 minutes: (e.g. 5-10km run, sprint distance triathlon, criterium cycling race) – typically no need for extra carbohydrate during the session. Small amounts of fluid may be required depending on sweat rates.
Sessions or events lasting longer than ~90 minutes: (e.g. marathon, Olympic distance triathlon, many team sports) – likely to be benefits to topping up your fuel (carbohydrate) stores during the session. The exact amount required will depend on the duration and intensity of the session as well as individual factors such as tolerance and taste preferences. Potential for dehydration during these longer sessions, particularly if the weather is hot and humid, however the volume of fluid needed will depend on your individual sweat rate.

Hydration Goals	Hydration strategies
• Delay fatigue • Maintain mental acuity • Help regulate heat while in hot environment • Quench thirst • Prevent significant weight loss(sweating) • Speed recovery time	• Begin exercise well hydrated • For intense training : consume carbohydrate in form of sports drinks/snacks • Event lasting 1+hour(s): consume snacks containing salt or sodium

Do the Commercially Available Sports Drinks Meet the Recommended Guidelines?

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Abstract

Introduction : Sports drinks are designed to deliver a balanced amount of carbohydrate, fluid and electrolytes to allow an athlete to simultaneously rehydrate, refuel and replace sodium loses during physical activity. The objective of the study was to explore the composition of sports drinks in terms of quality and quantity of carbohydrate and electrolytes utilized. **Methods** : Twenty six popular Indian and International sports drinks brands were identified through web search and their details were collected from official websites of the respective brands. Products without Nutrition Facts Panel were excluded. Food labels were examined for nutrition facts panel, ingredient list and reconstitution formula. **Results and Discussion** : The Fifty products surveyed constituted of Ready to drink formula (28%), powders (58%) and tablets (14%). The serving size varied from 10g to 79g for powders (to be reconstituted by adding water up to 200ml -1 litre), 4.7-50g for tablet (to be reconstituted by adding water up to 100ml -750ml), 118-567ml for ready to drink formula. The average carbohydrate content was 7.2g and sodium content was 55mg per 100ml of products. The top carbohydrate sources in the products were Maltodextrin (56%), Fructose (38%), Dextrose (28%) and Glucose (26%). Most of the products had multiple sources of carbohydrates. Thirty-eight percent products had 2, 22% had 3 and 4% had 4 sources of carbohydrates. Maltodextrin plus Fructose (in 18% of the products) was the most common combination. Twenty six percent of the products contained sweetener. Sucralose was the most commonly used sweetener present in 54% of these products. In 12% of the products, sodium content was not mentioned on the label though salt was present in the ingredients list. **Conclusion** : Of the total products, 67% met the recommended range for carbohydrate of 4-8g per 100 ml and 63% met the recommended range for sodium of 23-69mg per 100ml.

Keywords: Rehydration, Carbohydrate - electrolyte drinks, Sports beverages

Introduction : Sports drinks are used widely by athletes involved in high-intensity physical activities. They are designed to deliver a balanced amount of carbohydrate and fluid to allow an athlete to simultaneously rehydrate, refuel and replace sodium losses during physical activity. The compositional range which provides rapid delivery of fluid and fuel and maximizes gastric tolerance and palatability is 4–8 g/100 ml of carbohydrate and 23–69 mg/100 mL of sodium.

During exercise, carbohydrate availability to the muscle and central nervous system can be compromised as the fuel cost of an athlete's training or competition program exceeds endogenous carbohydrate stores. This carbohydrate depletion can eventually impair performance of an athlete. Thus, performance during prolonged (>90 min) sports is highly dependent upon carbohydrate (CHO) availability from both endogenous (i.e., muscle and liver glycogen) and exogenous sources like Sports drinks. The type and quantity of carbohydrates provided in sports drinks varies according to the manufacturer. Certain factors like taste, osmolarity and gut tolerance are also considered in the formulation of sports drinks. Carbohydrates such as glucose, maltodextrin, fructose etc. are absorbed from the intestine via different transporter molecules and so differ in their rates of absorption. (3)Studies have shown that a combination of slow and fast absorbing carbohydrates is required for sustained energy release. Therefore a judicious combination of carbohydrates in sports drinks is advisable instead of only one carbohydrate source.

Sodium containing beverages help to replace the sweat sodium losses incurred during physical activity. They can also encourage fluid intake by driving the thirst mechanism. Presence of sodium in the sports drinks also promotes fluid and carbohydrate absorption which helps in rehydration and delay in muscle fatigue respectively. Sodium also facilitates retention of fluids and decreases the urine output. Sodium concentrations of ~ 10–25 mmol/l

enhance the palatability and voluntary consumption of fluids during exercise. Consuming sports drinks can be more beneficial than plain water as the sodium content in these drinks if present in the appropriate quantities help maintain plasma sodium concentration. Whereas consuming only water for longer and strenuous physical activities can lead to hyponatremia. Other electrolytes like magnesium, potassium and calcium may also be found in sports drinks. Current evidence indicates that significant quantities of magnesium are not lost during exercise so it is unlikely that additional quantity of this mineral will enhance hydration goals or reduce cramping.

Protein or amino acids (2% or 2 g/100 ml) can be found only in a small number of commercially available sports drinks. Limited studies show that sports drinks providing protein/amino acids are superior to carbohydrate-electrolyte drinks in enhancing performance or recovery in specific exercise situations like prolonged exercise. But more evidence is required in relation to this.

Sports drinks provide a convenient option for simultaneously addressing fuel, fluid and electrolyte needs before, during and after exercise. Sports drinks can be consumed immediately before exercise to enhance fluid and fuel status and as a pre- cooling strategy for exercise in hot environments. During exercise, the major role of sports drinks is to continuously keep rehydrating and refuelling the athletes. Sports drinks can also be used post-exercise to assist with rehydration and restoration of carbohydrates. There is enough evidence showing that exercise-induced dehydration has a negative impact on exercise performance and therefore restoration of fluid balance is crucial after exercise. It is equally well known that muscle glycogen must be restored after exercise to avoid compromised subsequent performance. Sports drinks promote voluntary drinking and fluid retention to assist the athlete to achieve a fluid intake plan that keeps the fluid deficit incurred during exercise to an acceptable level.They also supply carbohydrates in an easy to consume form to provide an additional fuel source for the muscle according to the requirements of each sporting activity. Moreover, the exposure of receptors in the mouth to carbohydrate creates a favourable response in the brain and central nervous system, decreasing the perception of effort and improving pacing strategies.(1)

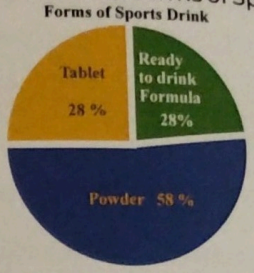
The sports supplements market is flooded with Sports drinks. These drinks vary in composition mainly with respect to the carbohydrate content, sources of carbohydrate utilized and sodium content. Despite the diverse composition of available Sports drinks, not enough Research has been undertaken to explore the same.

Methodology : The objective of the study was to explore the composition of sports drinks available in the Sports Supplement stores. The composition of these products was studied in terms of carbohydrate and electrolyte content, ingredients used and cost. All (three) the sports supplement stores in the city of Vadodara, Gujarat, India were identified. All sports drinks from the websites of these stores were listed. Further, the detailed composition of these products was accessed from official websites of the respective brands. Products that did not provide Nutrition Facts Panel were excluded from the study.

Results and Discussion : In all, fifty products from 26 brands were surveyed mainly for their composition in terms of carbohydrate content, source of carbohydrate and sodium content. The products were in the form of Powder, Ready to drink formula and tablets. The supplements available in powder and tablet form have to be reconstituted into beverage by adding to water. Figure 1 shows the percent distribution of various forms of products.

Figure 1

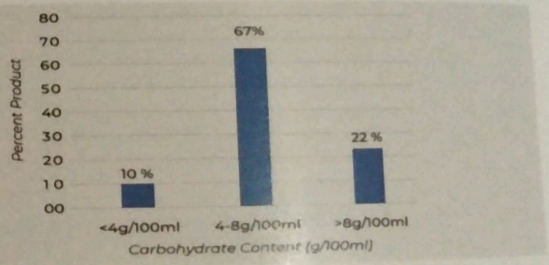
Percent distribution of various forms of Sports drinks



The serving sizes of the sports drinks varied from 10g to 79g for powders (to be reconstituted by adding water up to 200ml -1 litre), 4.7-50g for tablet (to be reconstituted by adding water up to 100ml -750ml), 118-567ml for ready to drink formula. While drinking sports drinks in powdered or tablet form it is important to follow the manufacturer's instructions regarding reconstitution to ensure that the carbohydrate and electrolyte balance is optimal for gut absorption, fluid balance and fuel delivery. Incorrect preparation may lead to gastrointestinal discomfort and a negative impact on performance.

Figure 2 :

Carbohydrate content per 100ml of Sports drinks



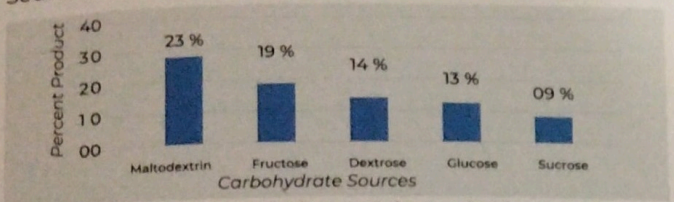
The recommended range of carbohydrates in Sports drinks is 4-8g/100ml. Majority of the products i.e. 67% fell in this range. Around 10% products had carbohydrate content less than 4g/100 ml. Products containing carbohydrates less than the recommended range may not be sufficient to assist refueling and thereby not be of much use. Around 22% had carbohydrate content more than 8 g/100 ml. Products having carbohydrates in greater quantity than required may cause abdominal discomfort, gut intolerance and delay gastric emptying.

The top sources of carbohydrates in sports drinks under study are depicted in the Figure 3 and discussed here forth. The top carbohydrate sources in the products were Maltodextrin (56%), Fructose (38%), Dextrose (28%) and Glucose (26%). Thirty-eight percent products had 2, 22% had 3 and 4% had 4 sources of carbohydrates. Maltodextrin plus Fructose (in 18% products) was the most common combination. Studies have demonstrated that ingestion of multiple transportable carbohydrates reduced fatigue and improved exercise performance compared to single carbohydrate. Literature suggests that amongst various carbohydrate combinations, Maltodextrin and fructose is more suitable as these two sugars have different absorption pathways and can significantly increase the fuel

available to the body when combined.

Figure 3

Sources of Carbohydrates in the Sports drinks under Study

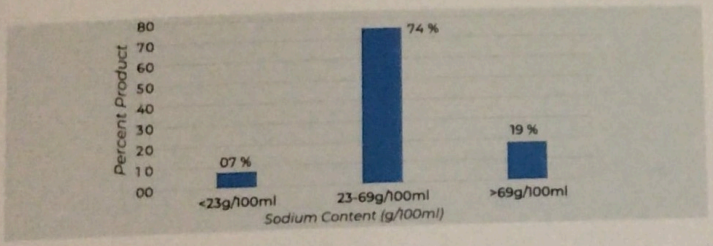


Twenty six percent of the products had presence of sweetener. Sweeteners are used to create low calorie products while still maintaining the taste that consumers like. Sucralose (54%) was the most commonly used sweetener. Sucralose is a low calorie sweetener and is 385 to 650 times sweeter than sugar.

The recommended range for sodium content in sports drinks is 23-69 mg/100ml and almost 74% products fell in that range as can be seen from Figure 4. Around 7% products contained sodium below 23mg/100ml.As these products contain sodium below the recommended range, excessive consumption of these drinks can result in low plasma sodium concentration. This can cause headache, lethargy, fatigue, decreased concentration, muscle cramps, etc. which can adversely affect performance of an athlete. Nineteen percent products contained sodium above the recommended upper range which can cause hypernatremia or high plasma sodium concentration. This condition is also not desirable as it can cause dizziness, diarrhea and vomiting.

Figure 4 :

Sodium content per 100ml of Supplements



In 12% of the products, sodium content was not mentioned on the label despite salt being present. This can be considered as a huge product labeling drawback. None of the products had fats or protein and they are neither required nor desired to be present. Ten percent of the products had caffeine. Caffeine is added to certain sports drinks in small to moderate doses (75 to 200 mg), to help sustain exercise performance, reduce perception of effort and is unlikely to alter hydration status during exercise. Moreover, caffeine is no longer banned by The World Anti-Doping Agency. Nevertheless excess caffeine intake can result in side effects like anxiety, jitteriness, rapid heartbeat, gastrointestinal distress, and insomnia and could be ergolytic for novice users. Therefore drinks containing caffeine should be avoided unless dire need.

Conclusion : Of the total products, 67% met the recommended range for carbohydrate of 4-8g per 100 ml and 63% met the recommended range for sodium of 23-69mg per 100ml. As the remaining products did not meet the guidelines they may not fulfill the targeted functions. Thus it is important to educate the athletes to choose the right products if at all to derive maximum benefit and avoid adverse effects. Also the manufacturers should design the products keeping in mind the latest guidelines.

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