INTRODUCTION
CHAPTER I
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Sports performance is indeed an aspect of complex human performances, which has several dimensions, hence several disciplines of sports sciences are required to work in a co-ordinated manner to explore the nature of sports performances and the process of improving sports performances. In the last few decades several disciplines of sport sciences have been established e.g. Sports Medicine, Sports Physiology, Sports Training, Sports Biomechanics, Sports Psychology, Sports Pedagogy, Sports Nutrition and so on. These sport sciences work as integrated whole to give a superb sport performance.

Science of sports nutrition has got a unique importance among all the sport sciences. It is in fact the foundation on which the essence of sports performance is based. Man has known the relationship of diet and his physical ability, for this he has been engaged in a constant search for a diet that will enable him to develop a superb physique and give likewise performance.

Nutrition is the process of changing food chemicals in to structural and functional metabolites. During the past century, more than 40 different nutritional factors have been isolated and identified as essential for human health and well being. A basic understanding of nutrition and its effects upon health, growth, weight control and physical performance is essential for all people, including the coach, trainer, and athlete. An athlete’s performance may be improved with good sound nutrition, while at the same time, it may deteriorate with poor nutritional
process. Nutrition is a form of applied biochemistry to be used as judiciously and as expertly as every other aspect of medical care. To maximise benefits, nutritional guidance, and suggestions should always be geared to individual needs deduced from careful and pains taking medical and dietary histories, a physical examination and appropriate laboratory tests.

ENERGY SUBSTRATES AND THEIR AVAILABILITY

Bodil Nielson (1992) pointed out that all cells in the body use energy for their general activity the cost of living at rest. To this basal metabolic rate (about 100 KJ/Kg body mass/day) is added to energy needed for 'activity'. This total energy demand should be balanced by the energy intake in the food. An excess energy intake is stored as fat, resulting in overweight and obesity, while in the case of a negative balance, the energy stores of the body will be used resulting in weight loss, in the long terms, reduced performance capacity will occur.

The mechanism of muscle contraction and relaxation are fuelled exclusively by adenosine tri phosphate (ATP). The availability of ATP to skeletal muscle is \((5.5 \times \text{mole/Kg})\) and therefore it is continuously resynthesised from its break down products ADP and P. The energy for ATP resynthesis is derived from both aerobic as well as anaerobic processes. Aerobic resynthesis is achieved by the oxidation of glucose derived from muscle and liver glycogen stores of fat derived from circulating free fatty acids and intra muscular triglyceride stores, and to a lesser extent of protein. Anaerobic resynthesis of ATP requirements for a specific task cannot be met solely by aerobic metabolism and is achieved
by the degradation of phospho-creatine to creatine and of glucose to lactate per glucose unit, the total capacity of anaerobic metabolism to resynthesize ATP is relatively small in comparison with aerobic metabolism however, the potential rate of resynthesis is far greater for anaerobic metabolism of the three available energy substrates, fat is the most abundant in humans and is comprised almost exclusively of triglycerides which are stored mainly in adipose tissue. The mobilisation of adipose tissue, which is under fine hormonal control, results in the breakdown of triglycerides and the release of free fatty acids from adipose tissue into the circulation. The low concentration (0.3 – 3.0 × mole) and short half-life (less than 2 min.) of circulating free fatty acids demonstrate that they are rapidly utilised as fuel source. The remainder of the body’s fat stores are represented by circulating esterifies fat and intra muscular triglycerides both of which are of minor importance to energy production compared with adipose tissue.

In comparison with fat, the stores of Carbohydrates available to humans for ATP resynthesis are minute, amounting to only 2% of the total energy available from fat. Skeletal muscle provides the major stores of carbohydrate in humans (about 350 gm.), in the form of glycogen. However, during a normal working day the muscle glycogen store is not usually utilised. This is in contrast to the other main carbohydrate store, liver glycogen, which may fluctuate from about 150 gm. to practically zero. The liver provides the only store of carbohydrate that can be mobilised and released, in the form of glucose, for use by other tissue; it can be totally replenished only by dietary carbohydrate intake. Hepatic
glucose formulation from gluconeogenic substrates (lactate, amino acids and glycerol) taken up from the circulation amounts to about 80 gm/day.

Like fat, protein is widely available for use as an energy substrate. However, no specific stores of protein for use, as energy substrate exists in the body. If energy intake is unrestricted, protein (amino acid) oxidation will provide about 2% of the total energy requirement during exercise, increasing to a maximum of 10% during prolonged exercise when the carbohydrate stores are exhausted. Possible sources of amino acid for energy production include the free amino acid pool in muscle and plasma and those released during normal protein catabolism. There is no evidence to suggest that contractile protein be utilised for energy production during exercise.

Cathcart, in 1952, suggested that physical activity increases, ‘if only in small degree’, the metabolism of protein. More recently, authors have provided further evidence of the role of protein in activity. The role of protein metabolism as an energy source has mostly been ignored and declared insignificant. However, with prolonged exercise (60 mins. at 60 to 70% of aerobic capacity some amino acids are oxidised during exercise to provide amino groups (\(-\text{NH}_2\)) Sixteen amino acids have been identified as glycogenic with leucine, isoleucine, and valine the most readily available. Leucine, for example is degraded to (\(-\text{NH}_2\)) and (\(\text{CO}_2\)). Then \(\text{NH}_2\) radical combines with pyruvic acid to form alanine. Alanine is transferred from the muscle, via the circulation to the liver where it is de-laminated to from urea and pyruvic acid. The pyruvic acid is then converted to liver glycogen and glucose. The glucose then can be
recirculated to the working muscle to provide energy for muscular contraction. This process is called ‘glucose-alanine’ cycle.

The process of protein metabolism is significant in at least three ways.

1. Amino acid conversion to Krebs’s cycle intermediates enhances the rate of oxidation of acetyl Co-A generation from glucose and fatty acids.

2. Increased conversion of amino acids to glucose helps or event hypoglycaemia.

3. Oxidation of some specific amino acids may provide energy for muscular contraction.

Thus, Main nutrients of diet are carbohydrates, fats and proteins. They are also known as proximate principles. 1 gram of carbohydrate yields 4 cal, 1 gram of fat yields 9 cal. and 1 gram of protein yields 4 calories of energy approximately.

The carbohydrates, fats and proteins in the diet supply practically all of the energy required by the body. From the energetic point of view, it makes no difference whether the energy is delivered by oxidation of 1 gm. Protein (1 gm. yields about 17 kJ) or 0.44 gm. Fat (1 gm. yields about 39 kJ). After digestion and absorption in the gastrointestinal canal, these dietary constituents appears in the blood in the form of hexose’s (Mostly glucose, maltose, and fructose from carbohydrates, triacylglycerols (from fats) and amino acids from (proteins). Most of the
ingested food is oxidised in the cell. The rest is stored for the times being in the energy depots of the body. These include the carbohydrate stores of glycogen in the liver and in muscle tissue and the much larger fat stores in adipose tissue, (beneath the skin, around the organs of the abdomen, and also in the muscle tissues). Converted to more specific proteins in the tissues; or converted and stores as either glycogen or fat (after de-amination). There are no specific protein stores.

**CARBOHYDRATE**

Carbohydrate is the chief source of energy for all body functions and muscular exertion. This leads to a rapid depletion of available and stored carbohydrate and creates a continual craving for this macronutrient. Carbohydrate intake should not be less than 40 percent of total caloric intake – typically, it should be between 50 and 70 percent.

The principle carbohydrates present in foods occur in the form of simple sugars, starches and cellulose. Simple sugars, such as those in honey and fruits, are very easily digested. Double sugars, such as table sugar, require some digestive action but they are not nearly as complex as starches, such as those found in whole grain. Starches require prolonged enzymatic action in order to be broken down in to simple sugars (i.e., glucose) for utilisation. Carbohydrates maintain satiety by keeping glycogen stores full and adding bulk to the diet. It also spare protein for building muscle, carbohydrates also help to regulate the digestion and utilisation of proteins and fats.
LIPIDS

Lipids (i.e., fats) are the most concentrated source of energy in the diet. One gram of the fat yields approximately nine calories when oxidized, furnishing more than twice the calories per gram of carbohydrates or proteins.

In addition to providing energy, fats act as carriers for the fat--soluble vitamins A, D, E, and K. By aiding in the absorption of vitamin D, calcium is also available to body tissues, particularly to the bones and teeth. Fats are also important for conversion of carotene to vitamin A. Fat intake can range from 10 to 30 percent (according to performance, satiety and platability).

PROTEIN

Protein is exceptionally important to the maintenance of good health. Additionally, it is vital to the growth and development of all body tissues. It is the major source of building materials for muscles, blood, skin, hair, nails and internal organs (e.g. heart, brain).

Protein is needed for the formation of hormones, which control a variety of body functions such as growth, sexual development and metabolic rate. Protein may also be used as a source of heat and energy, providing four calories per gram. However, this energy is spared when sufficient fats and carbohydrates are present in the diet. Unlike carbohydrates and fat, the body is not able to store protein. Glucose is stored as glycogen and fats are reserved in adipose tissue, whereas protein is available only through the working molecular and structural
components of endogenous body tissues. When the need arises, the body dismantles its tissue proteins and utilises them for energy. The tissues of the liver are the first to be broken down, followed by the muscle tissues and then other organs.

Recommended Protein intake: < 30% of total caloric intake (with the exception of specific populations and goals). Typically 15 to 25 % during adaptation periods spread throughout meals.

VITAMINS AND MINERALS

Most Vitamins serves as essential parts of enzymes or coenzymes that are vital to the Metabolism of fats and carbohydrates thus although vitamins do not yield energy in themselves they are essential to life, i.e. they are nutrients. These nutrients obtained from ingested food provides the building blocks for the athletes growth, development and maturation plus the fuels elements for routine energy expenditure and for initiation and maintenance of high level performance.

SUPPLEMENTS

Generally, it is felt that some of the important nutrients in the diet at times are lacking, so readymade supplements available in the market may provide the deficient nutrient to fulfil this gap, which is necessary for appropriate growth and development to fulfil the demands of the physical activity

Most of the people in the world use the word “supplements” to describe a nutrient formulation or some type of compound i.e. Drug Free
or "natural". Some use terms like Sports supplements, Performance supplements, Body building supplements etc. Dietary Supplements Health and Education Act of 1994 (DSHEA), Supplements or Dietary supplements as the FDA calls them, are defined as- Vitamins, minerals, herbs, or other botanicals (except Tobacco), amino acids, or any dietary substance for use by man to supplement the diet by increasing the total dietary intake.

This definition of supplements is quite broad and has allowed a whole slew of new product to be brought to the market as "Supplements". A number of drug companies which were developing new products with the intent of bringing them to the market as pharmaceuticals are now looking to get in the dietary supplement business. According to this law, dietary supplements includes many of the things one would suspect, such as vitamins, antioxidants, minerals, amino acids, protein powders and so on. However, it is interesting to note that "Dietary Supplements" now include many things that prior to late 1994, might have been considered drugs or "unapproved food additives" by the FDA. Look at DHEA and melatonin for example. These very popular 'supplements' are synthetically manufactured pro-hormones that exert 'drug like' effects on body.

The first way a supplement might help one to build muscle, lose fat, and improve one's health is simply by making up for deficiencies. This has basically been what most dieticians, nutritionists, doctors etc have viewed supplements as – a means of protecting ones body against vitamins and minerals deficiencies and so on. Vitamin supplements have
been widely used for decades as a means of preventing serious, even fatal diseases, which are caused by nutrient deficiencies. It’s widely accepted that active individuals, like body builders and other athletes who exercise intensely, have great demands for a number of nutrients, which makes it even that much more likely we will suffer deficiencies without supplementation. And if a person deficient in one or more nutrients, it’s quite possible that one’s body may not be able to build muscle and burn fat properly.

Keeping in mind the importance of supplements associated with proper growth and development, it is pertinent to describe various readymade supplements available in the market in various combinations:

**CREATINE**

Readymade creatine a concentrated nutritional supplements available in the market, a compound that is naturally made in our bodies to supply energy to our muscles. Chemically, it is called “methylguanido – acetic acid”. Creatine is formed from the amino acid arginine, methionine and glycerine through chemical process. Creatine is manufactured in the liver and may also be produced in the Pancreas and kidneys. It is transported in the blood and taken up by muscle cells, where it is converted in to creatine phosphate (CP), also called “Phospho-creatin”. This reaction involves the enzyme creatine kinase, which helps bond creatin to a high-energy phosphate group.

The most popular form of creatine on the market is creatine monohydrate. All of the recently published scientific studies have been
conducted with this form. It is virtually tasteless and is an adequately soluble compound in water. Creatine monohydrate contains more creatine per weight of material than any other form of creatine. It’s simply a molecule of creatine with a molecule of water attached to it so it’s more stable. When creatine monohydrate dissolves in water, the molecule of water that was attached to it is released, as is the creatine. Creatine monohydrate contains about 880 mg of ‘free’ creatine in every gram. In this form, creatine can be purified and stabilised.

Typically, the average person metabolises about 2 gm. creatine/day, and the body normally synthesises that same amount; thus, one generally maintain a creatin balance. Once creatin is bound to phosphate group, is permanently stored in a cell as phospho-creatatin until it is used to produce chemical energy called adenosine tri- phosphate(ATP). When this takes place, creatin can be released spontaneously form creatinine, which is then removed from the blood via kidneys and excreted in the urine. Although creatine supplementation can raise blood creatinine, it has never been shown to be toxic or harmful to the kidney.

**WHEY PROTEIN**

It is very necessary to all the power lifters to understand the importance of protein supplementation. Weight-training athletes requires more protein than sedentary folks. Without protein (which the body breaks down in to amino acids), one can’t build muscle, no matter what kind of diet follow-whether it’s low or high in complex carbohydrate or fats-and deposit the number of calories one take in, ones diet must be rich with protein.
Whey protein have superior biological value (which means it may ‘yields’ more usable grams of amino acids than other protein supplements), it’s also very low in lactose (that nasty milk sugar that upsets many people’s stomachs). Whey protein – ion exchanged, micro filtered whey protein/peptides – is extremely high quality and very easy to use, which is another thing that is terrific about it.

Whey protein also seems to support the immune system which is ‘taxed’ by intense exercise. A scientist named Dr. Bounous and his colleagues at McGill University (in Canada) completed a series of studies which demonstrated whey protein was superior to egg albumin, soy, beef, and fish (to name a few) with regards to enhancement of both cellular and hormonal responses. Careful analysis revealed that the immuno stimulating action of whey was due to the overall amino acid makeup whey contains just the right amino acids in the right concentration. Whey protein has also been found to increase levels of glutathione (water-soluble antioxidant).

The harder and more intensely you train, the more important dietary protein becomes in maximising the muscle building process. For serious power lifters, protein intake of 11.5 gms of quality protein per pounds of body weight per day is recommended.

In addition to providing one’s muscles with the vitally important amino acids it needs to grow, protein also has a nice effect on insulin stability and energy levels, especially during a diet. By consuming
protein with each meal, there is a greater chance for blood sugar levels to fluctuate. This can help one to control one's appetite and provide a consistent environment for greater fat loss. If one consumes a diet that's too high in carbohydrate, levels fluctuate all day.

**GLUTAMINE**

Glutamine is generally not considered an "essential amino acid" by nutritionists. It can be synthesised from a number of amino acids, notably glutamic acid, valine, and isoleucine. But in times of disease and stress (weight training is stress), certain parts of the body demand so much Glutamine that the body can't manufacture enough. In these instances, Glutamine supplementation could make a world of difference. In fact, in European hospitals, this amino acid is treated like a drug – it's routinely administered to patients suffering from stress or trauma (surgery, burns, disease etc.). Studies have shown this type of Glutamine supplementation can prevent anti-catabolic effect.

Almost everyone is fascinated by top ranking athletes. Explosive movement shown in low motion reveals a masculine, so that it seems as if it could tear apart, each fibre standing out under the skin. For a second, each of us dream of having a body like that, but than one realise that such record performances not only demand a specific genetic pre-disposition but also a daily training programme that is carefully planned down to the last detail.

If one looks at the matter more closely, one discovers that the hereditary disposition of top ranking athletes and that of men and women
who play main sports only differ to a slight extent with regard to physical fitness. If however, one looks at the training programme involved than visible differences are revealed. Top ranking athletes, not only, as a rule, commence training several year’s earlier, but also in most cases train together with an experienced who is tuned in to their physical requirements. The training programme is precisely planned in advance and regularly examined to asses whether the desired results have been obtained.

Weight Training is not usually thought as an end in itself, but as a means to an end. The primary objective is not to learn to lift as much weight as possible but to increase strength and power for application to some other sports. Weight training may be either of isometric contraction, isotonic, or iso-kinetic contractions.

There are some noteworthy advantages in training with weights than other type of strength training, since weights can be added to the bar in small amount it is easy to control the resistance to the working muscle. By recording the amount of weight lifted in each day the trainer is able to increase gradually and accurately increase the overload of a muscle group during a workout and from one workout to the next.

Many are of opinion that exercising certain part of the body will reduce the fat tissue of that particular region. This is erroneous because the muscle being used is fed by the blood stream, which in turn draws its supply from the entire body. Alternations in the body composition as a result of high resistance weight training programme are found to be
nearly identical for both men and women. There is an increase in lean body weight and a decrease in total body fat with relatively little change in total body weight.

With the advent of new physical fitness test, the physical education teachers/coaches are more interested to find out the body composition of the athletes. Because it affects the performance and changes as the physical activity changes. So it is important to know the norms of body composition of individual athletes.

It is debatable question that whether all supplement available in market has effect on anthropometric measurements, body composition, and performance. There are many irreputable companies and ‘snake – oil salesman’ that is blatantly ripping consumers off left and right. They use false advertising and other scams to make quick buck. Unfortunately, trying to figure out what works and what doesn’t can be a confusing and sometimes frustrating endeavour, as there are so many supplements in the market, and which all claiming to ‘perform miracles’.

This is a very pertinent question before all of us to assess the effectiveness of these readymade nutritional supplements in comparison to nutrients taken through natural dietary process on anthropometric measurements, body composition and performance of upcoming athletes. Thus, in the present study within the confines of resources available the researcher has undertaken the task of comparing the effectiveness of nutritional supplement by the name of muscle blaster (readily available in market and very popular among power lifters and body builders), with
nutrients taken through natural diets on selected anthropometric measurements, body composition and performance variables. This all had led him to state the problem as: *Effect Of Nutritional Supplements On Anthropometric Measurement, Body Composition and Performance of Power Lifters.*

**DELIMITATIONS**

The study was delimited to

1) Thirty male power lifters age ranging between 18-20 years of age group.

2) **BODY COMPOSITION:** B.C was determined by using Durnin and Womersley method.

3) **ANTHROPOMETRIC MEASUREMENTS** (Ponderal index, Crural index, Weight, Upper arm length, Fore arm length, Biacromial, Chest Girth, Upper arm Girth, Thigh Girth, Calf Girth).

4) **PERFORMANCE** (Bench Press, Full Squat, and Dead lift).

5) **DIET**

   (a) Normal Balance Diet.

   (b) Diet with high Fat Protein (HFP).

   (c) Normal Diet plus Readymade Supplement i.e. Creatine monohydrate (Muscle Blaster) (N$D$).
LIMITATIONS
1) Difference in genetic background might create some minor variation on results.
2) The method for calculating the raw food materials used could not get the exact and accurate value of foodstuff because during cooking some value of foodstuff gets wasted.
3) Even though all precautions were taken during the course of study to have similar life style of the subjects in relation to their diet, training and living habits. Even then slight variations which were unavoidable might have some infringement on the study.

HYPOTHESIS
Keeping in view the objectives of the study and the review of literature available following hypotheses were formed:

1) It was hypothesised that normal diet plus readymade nutritional supplement shall have more significant effects than normal balanced diet and high protein and fat diet on Anthropometric measurement, Body composition and Performance of Power lifters.

2) It was further hypothesised that high protein and fat diet shall have more significant effect than normal balance diet on Anthropometric measurement, Body composition and Performance of Power lifters.
SIGNIFICANCE OF THE STUDY

The study shall be of great significant value to body builders and power lifters in their search for supplements and appropriate dietary procedures for getting better results in lesser times. Thus the study will help in:

1) Highlighting the effect of nutritional supplements among the power lifters, weight lifters, and body builders.

2) The study will also helps the power lifters to identify the appropriate diet/supplements for optimum performance, effective anthropometric measurements and body composition in required direction.

3) Results will also help the coaches and physical education teachers to provide proper guidelines regarding nutritional supplements to power lifters, weight lifters and body builders.