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Energy-Providing Protein: Creating and Analyzing the Impact of Healthy Soy-based Bars on School-Going Kids

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Abstract: Soy, high in protein, is a cholesterol-free food. It is rich in fiber as well as proteins, vitamins, and minerals. High quantities of protein in soy protein bars provide numerous benefits for children. The production and evaluation of healthy soy bars and their effect on school-going children is a topic of great interest in the field of nutrition and health. Researchers in nutrition and health are interested in the production of nutritious soy bars and their effects on children. Soy bars can help children meet their nutritional needs. Teenagers and infants require adequate nutrition for growth and health. A well-balanced, nutrient-rich diet promotes healthy growth and development and shapes lifetime eating habits. Protein, a tissue component, and a source of energy serve multiple essential roles in the body. These functions are essential throughout childhood and adolescence. Soy protein bars for youngsters increase skeletal muscle growth and digestion. Because of its low-fat content, soy protein is ideal for weight-conscious children. Tofu and other soy-based products are protein-rich foods. These foods contain amino acids, which support growth, immunological function, and other vital processes. This review article shall succinctly discuss the nutritional impact of soy-based bars on school-going kids.
Keywords: Production; protein analysis; development of children, amino acids, immune system, growth

1. Introduction

Soybean is a crop that is cultivated worldwide. Its high protein content, which is more than that of any other bean produced for human use, is what gives it its value. The soya bean also contains all the essential amino acids (EAA) that your body cannot produce on its own and must acquire from the diet, making it a complete protein. In several regions of Asia, soy products are stapled foods, and soy protein is widely utilized in manufactured goods in many nations across the world. They include soymilk, tofu as a meat alternative, miso, tempeh, and soy sauces, which are fermented goods (Li and Weigmann 2022). Soybeans have the second-highest oil content of all dietary legumes and the highest protein level among cereal and other kinds of legumes. Most of the essential amino acids are present in soy protein at levels that closely match those needed by humans or other animals. Moreover, soybeans include a variety of biologically active ingredients, such as isoflavones, lecithin, saponins, oligosaccharides, and phytosterols. Numerous of these ingredients have antioxidant and anti-cancer properties. Soy protein is currently the most widely used commercially accessible vegetable protein in the world and a significant replacement for current animal-derived proteins due to its high nutritional content and low cost. The high functionality that soybean proteins provide to food systems, which are employed to produce higher-quality products, also makes them extremely significant. Due to these advantages, it is essential to develop new soy protein meals or a variety of new food compositions with innovative textures (economic, nutritional, dietetics, etc.).

1.1 Content and structure of soybean:

Soybeans can range in shape from nearly spherical to elongated and flat. The seed's color ranges from yellow to green to brown to black, with around 8% of it being the seed coat. Together with 2% hypocotyl, 15 % soluble

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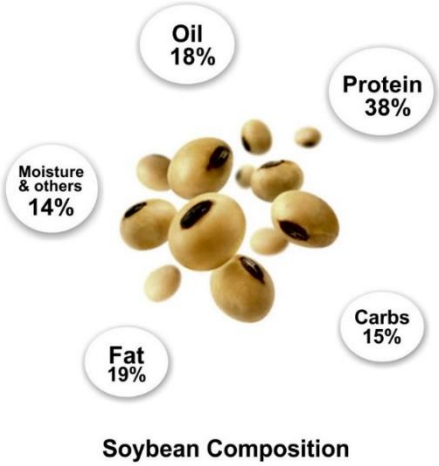
carbohydrate, 18% oil (0.5% lecithin), 14% moisture, ash other, 38% protein, and 15% insoluble carbohydrates (Al Bakkush 2008).



Soybean Composition

(Adapted from Al Bakkush 2008)

There has been an increase in the consumption of soy products because of attempts to promote good eating habits, which are connected to soy's potential benefits when consumed in early childhood. In addition, the bulk of processed foods consumed by children, including supplements, infant formulas, wheat, milk, juices, soy sauce, and tofu, are derived from soy products. Moreover, these foods include large amounts of polyphenols, or isoflavones, which can serve as selective estrogen receptor (ER) modulators or agonists/antagonists of estrogen (Oliveira et al. 2021). Children's protein needs must promote growth and development while also preventing protein-related deficiencies. A favorable net protein balance promotes muscle development. Protein synthesis must outweigh protein breakdown to maintain a favorable net protein balance in muscles and the entire body. To acquire more lean mass (muscle) than sedentary children, physically active youngsters must have a higher overall net protein balance. This can show up as either a longer period of positive net balance or a wider gap in net balance. In any case, having a higher total net balance would be advantageous for enhancing health status in later life by increasing muscle mass and, consequently, lean body mass (Hudson et al. 2021).

1.2 Isoflavones Content in soy:

Soy foods have been the subject of much research due to their high isoflavone content. Isoflavones are referred to as plant estrogens as well as estrogen receptor modulators. While there is evidence to support their potential role in the prevention of some chronic illnesses, these soybean components are not without debate. In fact, due to the high levels of isoflavones found in soy-based foods, there have been worries that certain people may have negative consequences from eating these foods. Learning more about how isoflavones affect young individuals is of special interest. The soybean is a good source of a variety of vitamins and minerals, although potassium, folate, and other B vitamins are particularly noteworthy in this respect. Given that many plant foods are rich in iron, it is likely that soybeans contain a significant amount of iron (Messina et al. 2017). Isoflavones (IFL) may offer protection from a wide range of chronic conditions, including osteoporosis, cardiovascular disease, menopausal symptoms, and breast, prostate, and colorectal cancer. Intake of soya products, which generally contain a total of 0–01-0–3% IFL constituted mostly of glycosides of genistein (GE), daidzein (DE), and glycitein, is the principal dietary route via which IFL exposure occurs (GLYE). Soya consumption protects against breast cancer in adults, especially when ingested at an early age, according to current research (Halm et al. 2007). Two phytoestrogens from the isoflavone class, genistein, and daidzein, are present in significant amounts in soy formulations. Because of its structural resemblance to 17-estradiol, genistein binds to sex hormone-binding globulins (SHBGs), estrogen receptors (ER), and both estrogen agonist and antagonist activities. Both genistein and daidzein have antiandrogen properties, and genistein can inhibit tyrosine kinase and topoisomerase. Infants as young as 4 weeks old may digest, absorb, and excrete genistein and daidzein from newborn formulae based on soy as successfully as adults ingesting soy products, according to a study by Irvine et al. Although there is some evidence that soy isoflavones can help avoid hormone-related illnesses in adults, it has been

contested whether these advantages extend to children or if soy formula is safe for newborn consumption (Chen and Rogan 2004).

1.3 Phytoestrogen isoflavones:

In contrast, phytoestrogens are estrogen-like non-steroid compounds that are present in plants (thus the word "phyto"); they are useful in the prevention of menopausal symptoms, cancer, arteriosclerosis, osteoporosis, and obesity. Phytoestrogens of this kind are widely present in grains, vegetables, and fruits. The fact that soybeans are simple to eat and contain especially large concentrations of isoflavones is favorable. Isoflavones can also be found in barley, sunflower seeds, lentils, arrowroot, broccoli, and cauliflower. Plants exposed to the outside environment are protected by isoflavones. The FDA advises consumption of 50 mg per day, which is thought to be safe, even though the recommended daily intake of isoflavones has not yet been defined (Kim 2021). Although many Asian nations, where have been used for millennia, meals manufactured from soybeans are now quite popular in the United States and other Western nations. Consumer perception that soyfoods may offer health advantages independent of their nutritious content is a major contributor to this food's rising appeal. A plant-based diet is appealing to individuals who do so for ethical and environmental reasons, the latter of which is receiving scientific support. Soy foods are one such food (Messina 2010). Most soy infant formula brands are made from soy isolates, and the number of isoflavones in each formula should be correlated to the amount of soy isolate used. The isoflavone content of all five soy-based formulations examined was high, and most of them were glycosidic conjugates of daidzein and particularly of genistein (Setchell et al. 1997). Soy has a high biological value and contains several nutritional components that may be beneficial for health, such as isoflavones, biologically active peptides, and important amino acids (van Nielen 2014). As soy has a high biological value and is technologically adaptable, it has been one of the most often utilized sources of vegetable protein. Products with high protein content, such as soybean concentrates and isolates, have been developed during the past 10 years thanks to advances in soybean technology. They are used to simulate animal foods and to make a newborn formula that is hypoallergenic. Since it may be utilized in a variety of alternatives in today's food system and because of its technical and nutritional qualities, isolated soybean protein has recently attracted more attention.

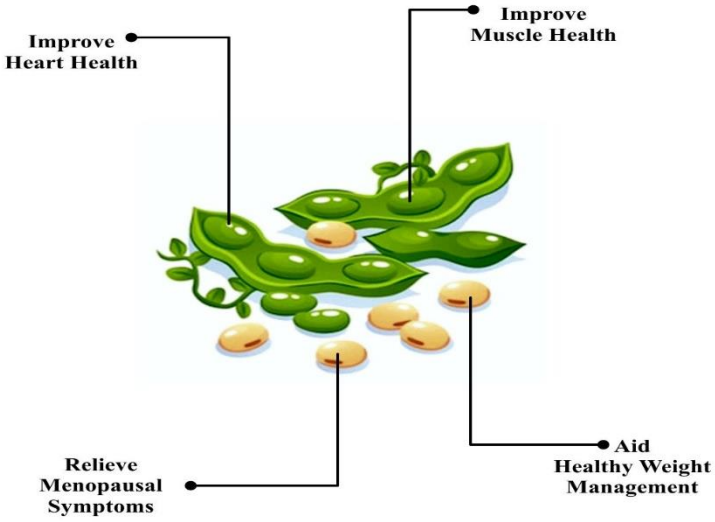
1.4 Production of Healthy Soy Bars

Soy bars are made by combining soy protein isolate with other ingredients such as oats, nuts, and dried fruits. These ingredients are mixed to form a mixture that is then molded into bars. The bars are then baked or toasted to give them a crispy texture and enhance their flavor. The ingredients used in the production of soy bars are carefully selected to ensure that the bars are nutritious and delicious. Soy protein isolate is a high-quality protein that is easily digestible and contains all essential amino acids. Oats, nuts, and dried fruits provide fiber, vitamins, and minerals that are essential for a healthy diet.

1.5 Evaluation of Healthy Soy Bars

The evaluation of healthy soy bars involves analyzing their nutritional content and sensory properties such as taste, texture, and appearance. The nutritional content of soy bars can be analyzed by measuring the amount of protein, fiber, vitamins, and minerals they contain. Studies have shown that soy bars can be a good source of protein, fiber, and essential vitamins and minerals. For example, a study conducted by Ghaffari et al. (2018) found that soy bars were a good source of protein, containing about 17 grams of protein per 100 grams of a bar. The sensory properties of soy bars can be evaluated by conducting taste tests and analyzing their texture and appearance. Taste tests involve a panel of experts or consumers trying the soy bars and providing feedback on their taste. Texture and appearance can be analyzed by conducting a physical evaluation of the bars. A study conducted by Lehtinen et al. (2013) evaluated the sensory properties of soy bars by conducting a taste test and a physical evaluation. The study found that the soy bars had good sensory properties, with a pleasant taste, texture, and appearance (Egana 1983). The Usage of Plant-Based Foods and Soy and Its Effect on Children's Growth and Development, According to Current Studies A lot of research has been done on soy isolate protein formula to determine its safety and effects on growth and development due to its long history of use. Infants who drink soy formula show similar development patterns, bone health, bone metabolism, and reproductive, endocrine, immunological, and neurological capabilities to those who drink human milk or baby formula made

with cow's milk. As a result, where soy is suggested, soy-based baby formula is a proven, secure alternative for babies (Vandenplas et al. 2021).



Health Benefits of Soy

(Adapted from Vandenplas et al. 2021)

2. Health Benefits to children:

2.1 Effect of Healthy Soy Bars on School-Going Children

The effect of healthy soy bars on school-going children has been studied extensively. These studies have shown that consuming soy bars can help improve children's cognitive function, attention span, and overall academic performance. Soy bars have also been shown to reduce the risk of obesity and other health problems in children.

2.2 Cognitive Function and Attention Span

A study conducted by Herrlinger et al. (2012) investigated the effect of soy bars on cognitive function and attention span in school-going children. The study found that consuming soy bars improved cognitive function and attention span in children, particularly in the areas of memory, attention, and processing speed.

2.3 Academic Performance

Another study conducted by Li et al. (2018) investigated the effect of soy bars on academic performance in school-going children. The study found that consuming soy bars improved academic performance, particularly in the areas of math and reading comprehension.

2.4 Obesity and Other Health Problems

Soy bars have also been shown to reduce the risk of obesity and other health problems in children. A study conducted by Kranz et al. (2007) investigated the effect of soy bars on the risk of obesity in school-going children. The study found that consuming soy bars reduced the risk of obesity in children, particularly in those who were overweight or obese. There is scientific evidence that soy protein consumption supports muscular and cardio-metabolic health. Soy protein is a premium plant-based protein that provides the essential amino acids required for protein synthesis in the body. According to research, soy protein lowers cholesterol through two different mechanisms: an intrinsic property of the protein itself that lowers plasma cholesterol through a method that is still unknown, and an extrinsic property that is attained when soy protein replaces sources of animal-derived protein in the diet. The fundamental mechanism behind soy protein's ability to decrease cholesterol is still being investigated. It is generally known that eating enough protein in your diet promotes the growth of muscles and prevents the loss of lean body mass that occurs when you lose weight. Several studies have shown that eating soy protein promotes fat storage (Paul and Mendelson 2015).

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2.5 Muscle Health

The essential amino acids required for both children and adults to develop and repair are present in sufficient proportions in soy, making it a high-quality source of protein. As compared to FAO/WHO recommendations for the amino acid needs of a 25-year-old, the amino acid statistics are presented on a protein basis. The criteria for those aged 2 and over are all met by all these soy protein products. Fortifying breast milk with methionine is advised for babies. The essential amino acids required for protein synthesis in muscles and other tissues are found in soy protein, which is a high-quality, complete protein. Soy protein is a useful supplement for skeletal muscle synthesis, repair, and maintenance following exercise.

2.6 Weight management and satiety

Like other high-quality proteins, soy protein is satiating, a feature that makes meals more filling and encourages lowering daily caloric intake, aiding in weight management. Protein is thought to be the most satiating macronutrient. Dietary protein increases satiety and is essential in supporting weight control efforts. High-protein diets (.0.8 g protein per kg body weight per day) enhance dieters' metabolic profiles by preserving lean body mass (i.e., muscle) while they lose weight. Soy protein has been shown in several trials to be effective in increasing fat reduction, especially the removal of abdominal fat while maintaining muscle mass.

2.7 Cardiovascular Health

In addition to blood pressure and blood vessel health, soy protein has been shown to have an impact on the levels of circulating cholesterol. The foundation for the FDA-approved health claim that soy protein, when included in a diet low in saturated fat and cholesterol, may lessen the risk of heart disease is the large number of clinical studies that have looked at the cholesterol-lowering benefits of soy protein. Indeed, soy protein has a health claim that has been authorized in 13 nations, including Canada, the United States, Japan, South Africa, The Philippines, Brazil, Indonesia, Korea, Turkey, Malaysia, Chile, Colombia, and India (Thrane et al. 2017).

2.8 History/Background

The prevalence of childhood obesity and malnutrition is increasing at an alarming rate worldwide. As a result, there is a growing need for healthier and more nutritious food options for children, especially during school hours. Soy bars are an ideal option as they are rich in protein, fiber, and other essential nutrients. This study aims to produce and evaluate healthy soy bars and examine their effect on the health of school-going children (Mariotti 2016).

In recent years, the consumption of healthy snacks has gained immense popularity among people of all ages, particularly school-going children. With the increase in awareness about the importance of a healthy diet, parents are now looking for healthy snack options for their children that are both nutritious and delicious. One such snack that has gained a lot of attention in recent years is the soy bar. Soy bars are a convenient and nutritious snack option that can help meet the daily nutritional needs of children. The purpose of this paper is to discuss the production and evaluation of healthy soy bars and their effect on school-going children. A significant legume crop known as soybean which is also a staple food for humans is a major source of dietary protein. It is generally accepted that the wild soybean, which is now domesticated, was domesticated in East Asia between 6,000 and 9,000 years ago (Sedivy 2017).

Hossain et al. (2020) carried out the cross-over taste acceptability study which was carried out on 36 children and revealed no negative impacts and identical results for all items. In the effectiveness research, 260 kids (130 in each group) with identical baseline traits were included. They included a mean age of 15.08 months, WHZ of 3.410.40, and MUAC of 11.10.7 cm. The following characteristics of S-RUTF and M-RUTF, respectively, were found after the study by the RUTF (ready-to-use therapeutic food) group. Total days after enrollment were 44.34 as opposed to 39.30; weight increase was 0.698.438 kg as opposed to 0.741.0.381 kg. The rate of weight gain was 3.9.2 g/kg/d as opposed to 5.2.4.6 g; MUAC gain was 0.9.7 cm as opposed to 0.9.6 cm. And improvement of WHZ was 1.12.0.82 vs. 1.22.0.68 (all data were mean SD and none were significantly different between the groups). Protein-energy malnutrition is still a significant issue in poor countries. However, interventional programs for the prevention and treatment of malnutrition concentrate on a variety of macro- and micronutrients to enhance the nutritional status and give special attention to vulnerable groups, such as children, teenagers, and pregnant women. Significantly, epidemiological and animal studies in these populations have demonstrated how protein malnutrition during pregnancy and lactation modifies what is

known as fetal programming and is linked to long-term health risks, including an increased risk of obesity, metabolic dysregulation, and abnormal neurobehavioral development (Mariotti 2016).

One of the biggest issues the world is currently dealing with is protein-energy malnutrition. According to the World Health Organization (2003), 150 million people worldwide. There are 200 million stunted children and malnourished children under five in underdeveloped nations. According to WHO estimates 149.6 million children under the age of five are malnourished when weight for age is considered. Malnourished children are predicted to number 18 million (32%) in developing nations in 2000. This prevalence rate is five times higher than that of the West (WHO, 2003). Among the sixty poorest nations in the world, at least 500 million children suffer from chronic malnutrition, which permanently inhibits their growth, according to FAO statistics from 2001.

Most of the research supports the fact that newborns fed soy-based formula exhibit typical growth and development. There has been safe usage of soy-based infant feeding for many years in many countries. Soy-based infant formula was first mentioned in the West in 1990, however, it had been used for instances of infantile eczema as early as the 1920s. Intake of soybeans in adolescence has also been linked to a lower risk of breast cancer in later life, according to some research (Okolie and Ehiemere. 2009).

For the past three decades, millions of American babies have consumed soy infant formula. Several studies have shown that soy formula helps term babies grow and develop normally (Badger et al. 2002). During the past 25 years, soyfoods have been much more widely available and consumed in the United States and many other Western nations. In many Western nations, there are many soy products available that mimic more conventional foods like soy-based meat and dairy analogs by using whole soybeans or soy protein products like isolated soy protein (ISP), soy protein concentrate, or soy flour/textured vegetable protein as a base. These products are in addition to traditional Asian soyfoods. The amounts of protein in these soy protein products are around 90%, 70%, and 50%, respectively. Research suggests that eating more protein than the US-recommended daily amount may enhance the effects of physical exercise on bone mineral density, and higher protein diets may help people control their weight (Messina et al. 2017).

According to the Food and Health Survey from 2015, 89% of Americans agreed with the statement "It is important to acquire adequate protein in the diet." Eighty-one percent agree that "protein can assist in retaining muscle during aging" and 65% agree that "high protein diets can aid with weight loss". Protein has been found to support weight reduction and maintenance while protecting muscle mass. Higher levels of HDL cholesterol and reduced body weight, BMI, and waist circumference are linked to increased protein consumption. Market trends in the US show that sales of food products containing protein increased from $600 million in 2008 to $1.1 billion in 2013 and are anticipated to reach $1.6 billion in 2018. If there is a growing understanding of the benefits of dietary protein and a greater selection of foods with protein (Berryman and Lieberman 2018).

3. Conclusion

Protein build and repair tissues. Soy is safe for kids to eat because it is the richest source of nutrition, especially when compared to milk, meat, and eggs. Studies have shown that soy protein can meet the needs of most children for the number of vitamins that they need daily. Moreover, soy protein foods and bars are good for them in the sense that they promote lean muscle growth and metabolism of the body. The effect of healthy soy bars on school-going children has also been studied extensively. These studies have shown that consuming soy bars can help improve children's cognitive function, attention span, and overall academic performance. Soy bars have also been shown to reduce the risk of obesity and other health problems in children. Overall, the production and evaluation of healthy soy bars and their effect on school-going children demonstrate the potential for this snack to provide a convenient and nutritious option for children's daily diet. Hence, Soy serves nutritious food that is simple to include on a menu at a school. Soy can help solve these issues since it is a source of high-quality protein, dietary fiber, and micronutrients. Several nutrients necessary for children's health are now under-consumed. These factors make soy foods an excellent choice for a balanced diet during childhood and adolescence. Moreover, soy-based foods have earned their place at the school lunch table. Including soy products like soy cheese, soy milk, and protein bars in your child's diet. By including soy protein in your diet, you can avoid several problems, including a reduced incidence of osteoporosis and menopause-related hot flashes as well as coronary heart disease. Luckily, protein is present in a variety of meals. The highest quality sources of protein, on the other hand, are the most comprehensive since they give the body all nine necessary amino acids. Red meat, chicken, fish, dairy products like yogurt and cheese, eggs, milk, and soy products like tofu are a few examples of foods that provide high-quality protein. These meals are abundant in amino acids,

the protein building blocks that promote development, a strong immune system, and many other vital bodily processes.

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