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Alternative Protein source for Human Nutrition

Pruthvi Gowda Sudhakara

Vistula School of Hospitality, Faculty of Food Technology and Nutrition, Department of Dietetics, Warsaw, Poland.

Abstract:
The aim of the study is to present and describe the alternative sources of protein, such as animal protein and plant protein, and protein metabolism. Also important is the role of protein in human health, and how important protein is for human health. This study explains the structural characteristics relating to the functional properties of proteins, and various deficiencies that are caused by the lack of protein in human health. Furthermore, a survey conducted to analyse what types of proteins are consumed by humans and how many people rely on plant protein or animal protein.

Protein is important for most efficient health, homeostasis, and haematopoiesis. Getting sufficient protein can assist to hold lean muscle mass, save you anaemia and signs and symptoms of fatigue, and help a wholesome immune system. Animal supply ingredients are a terrific supply of protein, subsequently, there might be unique recognition of nutritious underutilized animal supply ingredients along with fit to be eaten insects. In this literature review, cutting-edge information on important principles in protein metabolisms such as absorption, transport, storage, utilization, and recycling are mentioned. It additionally discusses protein bioavailability and their dietary reputation assessment. Finally, the literature might be reviewed on techniques to deal with protein deficiency in human diets [1].

Keywords: Protein, Nutrition, Food Science, Dietetics

Introduction:

Proteins are polymers of about 21 different amino acids linked together by peptide bonds. Different proteins can have different chemical properties because of the variety of side chains created when these amino acids are joined, and very different secondary and tertiary structures. In peptides and proteins, the amino acids joined in a peptide chain can be grouped based on the chemical nature of the side chains. Side chains can be [2]:

- polar,
- non-polar.

Proteins are found in significant amounts in both animal and plant products. In developed countries, people get much of their protein from animal products. In other parts of the world, most dietary protein is derived from plant products. Many plant proteins are often deficient in one or more of the essential amino acids. Essential amino acids are defined as those that cannot be synthesized by an organism and can only be obtained from diet [2]. The special character of proteins lies in the subtlety and variety of variations, both in structure and in function, that nature imposes on this simple subject. The properties and functions of a particular type of protein depend entirely on the precise sequence of its amino acids, which is unique to that protein. Unlike polysaccharides, the exact length of the chain cannot be vague. If even

one amino acid is misplaced in the sequence, the protein is likely to lose its biological activity. Amino acid sequences in proteins are defined by the base sequences in the DNA that make up our genes [3].

Literature Review:

1. Role of protein in human health:

Proteins are crucial compounds that are beneficial and required for the increase and preservation of tissues and infinite organic processes. Proteins and peptides shaped from amino acid chains make up numerous hormones that transmit records among cells, tissues, and organs withinside the frame. Insulin and glucagon are peptide hormones that respectively sign the uptake of glucose withinside the cells and breakdown of glucose withinside the liver [1]. Protein helps with the growth and maintenance of the health of the body. They play an essential role in many bodily functions, including the restoration and repair of tissues in muscles, skin, organs, blood, hair, and nails. Of the 20 amino acids that make up protein, the body can make 11; the other nine must come from food. Under normal circumstances, your body breaks down the same amount of protein it needs to build and repair tissue. Other times, it breaks down more protein than it can create, increasing your body's needs. Hence, protein is necessary for the growth and maintenance of tissues. Your body's protein requirements depend on your health and activity level [4].

2. Protein metabolism:

Protein metabolism denotes the numerous biochemical strategies chargeable for the synthesis of proteins and amino acids (anabolism), and the breakdown of proteins via way of means of catabolism. The steps of protein synthesis encompass transcription, translation, and publish translational changes. During transcription, RNA polymerase transcribes a coding area of the DNA in a cell generating a chain of RNA, especially messenger RNA (mRNA). This mRNA series includes codons: three-nucleotide lengthy segments that code for a particular amino acid. Ribosomes translate the codons to their respective amino acids. In humans, non-important amino acids are synthesized from intermediates in primary metabolic pathways which includes the Citric Acid Cycle [5]. The liver is the primary site of synthesis for many proteins involved in functions as broad and critical as coagulation, transport, copper and iron-binding, and protease inhibition. These proteins include ceruloplasmin, iron-binding, iron-storing proteins, and α1-antitrypsin. Albumin is produced exclusively in the liver and is the predominant serum-binding protein. Liver failure or specific genetic abnormalities can lead to altered amounts and functions of these proteins with wide-ranging pathological implications [6].

3. Protein deficiency:

Protein deficiency or hypoproteinaemia refers to a low level of protein in the blood. This deficiency can occur when you don't have enough protein in your diet to meet your body's needs if you follow a diet that severely restricts protein intake. Unlike carbohydrates and fats, there is no mechanism to store excess amino acids ingested from food [7].

Some scientists hypothesize that high-protein diets may accelerate bone loss because, under certain conditions, protein acids block calcium absorption in the gut and amino acids, once in the blood, promote calcium absorption. But even these effects have not been consistently observed in scientific studies. Health study suggests women who eat more than 95 grams of protein a day have a 20 percent increased risk of wrist fractures [8]. Furthermore, high-protein diets only appear to accelerate the progression of kidney disease and liver dysfunction in people who already have kidney or liver dysfunction, not causing these

problems. However, the prevalence of kidney disease is relatively high and underdiagnosed [9]. Another theory is that a vegetarian diet contributes to protein deficiency. The idea is that cutting out all meat-based foods severely limits protein intake, sometimes to unhealthy levels. While this can happen in some cases, research shows that most vegetarian diets sourced from legumes provide enough protein. nuts and seeds [10].

4. Sources of protein:

Plant proteins can be used as a nutritional enhancer or substitute for animal fats or proteins to improve the nutritional value of foods as given in table 1 [11]. Vegetable protein is an incomplete protein with one exception - soy protein [12].

Table 1. Plant sources of protein and their examples

Plant sources of protein	Examples
Legume	Garbanzo beans, kidney beans, lentils, lima beans, navy beans, soybeans, split peas
Grain	Barley, brown rice, buckwheat, millet, oatmeal, quinoa, rye, wheat germ, wheat, wild rice
Vegetable	Green Peas, Spinach, Artichokes, Sweet Corn, Avocado, Asparagus, Brussels
Fruit	Apple, banana, cantaloupe, grape, grapefruit, honeydew melon, orange, papaya, peach, pear, pineapple, strawberry, tangerine, watermelon
Nuts and seeds	Almonds, cashews, filberts, hemp seeds, peanuts, pumpkin seeds, sesame seeds, sunflower seeds, walnuts (black)

4.1. Animal sources of protein:

Animal proteins are extensively used for the formation of protein debris withinside the meals enterprise, e.g., casein, whey protein, gelatine, egg proteins, myosin, and fibroin.

Proteins that come from milk are one of the maximum proteins usually used from animal sources, e.g., caseins and whey proteins. If milk is acidified or dealt with chymotrypsin, then the casein precipitates, even as the whey protein stays soluble. Whey proteins are extensively used withinside the meals enterprise because of their excessive dietary fee and notable purposeful attributes, e.g., emulsification, gelling, foaming, and thickening. Albumins are water-soluble globular animal proteins with incredibly low warmth stability. These are appealing proteins for the manufacturing of microparticles or nanoparticles as they may be extended to be had in a natural shape and are biodegradable and nontoxic.

4.2. Plant sources of protein:

Plant proteins come in a wide variety. They were recently highlighted as one of the important sources of proteins taking into account sustainability. Plant proteins are available in peas, soy, corn, rice, wheat, sunflower, pumpkin seeds, cashews, amaranth. Furthermore, soy protein has been directly linked to heart health [13].

Like animal proteins, plant proteins come in a wide variety. Until recently, many plant proteins have been much less studied than animal proteins. This is gradually changing and more information is

now available on many non-traditional dietary proteins. Proteins can be obtained from leaves, grains, oilseeds, and nuts. Leaf proteins have been extracted from macerated leaves and are very labile. They are easily denatured at around 50°C and undergo surface denaturation in a pH range of 4.5 to 6 [2].

5. Alternative protein sources:

5.1 Edible insects as sources of protein:

Edible insects have the potential to become an important source of human nutrition and can be produced more efficiently than conventional livestock, i.e., in terms of converting biomass into protein or calories [14]. The demand for meat is increasing worldwide and the scarce available land leads to the search for substitute protein sources. And now the question of the sustainability of meat production has even been raised. Edible insects are not only an alternative source of protein for human and animal feed, but they also fascinate with low greenhouse gas emissions, high food conversion efficiency, low land use, and even have the potential to convert low-value organic side streams into high-value protein products to be valued [15]. The nutritional value of edible insects is very diverse, primarily due to the large number and variability of species. Even within a group of insects, the nutritional values can vary greatly depending on the stage of metamorphosis, the origin of the insect, and its diet. The nutritional value also changes depending on the preparation and processing before consumption (dried, boiled, fried, etc.) [16].

Methodology:

The methodology of the survey:

The survey was conducted via the Internet (survey conducted online on the google forms) and was answered by 105 people. In the survey people were asked about the types of protein, the forms of protein consumed and the type of protein most frequently consumed, consumption of alternative protein, protein intake monitoring, insect protein, and their consumption. The questions asked to the people in the survey are below in the Survey Form.

The survey form:

1. Age

Your answer: _____

2. Gender:
   - Male
   - Female

3. Which source of protein do you consume regularly?
   - Plant protein
   - Animal protein

4. Do you calculate how much protein you consume every day?
   - Yes
   - No

5. What type of plant protein do you like to consume?
   - Tofu
   - Sprouted whole grain bread
   - Peanut butter powder
   - Oats

- Lentils
- Broccoli
- Others
- None

6. What type of animal protein do you like to consume?
   - Chicken
   - Beef
   - Pork
   - Fish
   - Eggs
   - Cheese
   - Milk
   - Kafir
   - Others
   - None
7. In a regular week, how many times do you consume plant proteins?
   - Every day
   - A few times a week
   - About once a week
   - I do not eat
8. In a regular week, how many times do you consume animal proteins?
   - Every day
   - A few times a week
   - About once a week
   - I do not eat
9. How often do you eat protein-rich alternatives of meat?
   - Every day
   - A few times a week
   - About once a week
   - A few times a month
   - Once a month
   - Less than once a month
10. What stands out as the best source of protein for you?
    - Animal Protein
    - Plant Protein
11. Do you eat protein-rich alternatives of meat (made from plants)?
    - Yes
    - No
12. Are you satisfied with the current variety of plant proteins available in mainstream supermarkets?
    - Yes
    - No

13. Have you ever tried protein bars made with insects?
    - Yes
    - No
14. Would you consider eating a protein source derived from insects? Please give a reason for your answer.
    - Yes
    - I would be willing to try
    - No
    - Other: _____
15. What do you prefer to use in your kitchen when you prepare meals?
    - Protein powder
    - Protein-rich food

Among the surveyed people, the largest group (35.2%) were people aged 24 years, as well as at the age of 26-30 (57.2%). The remaining 7.6% were the respondents over the age of 30 (Fig. 1). Moreover, 68.6% of men participated in the study and 31.4% of women (Fig. 2).

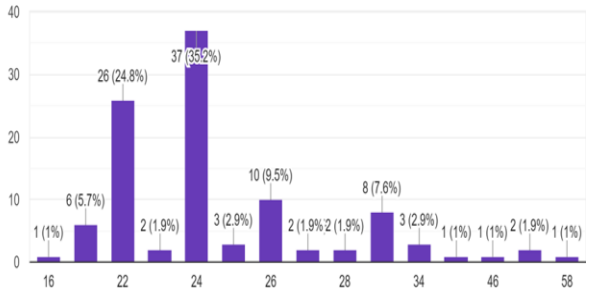

Figure 1. The characteristics of the surveyed people in terms of age

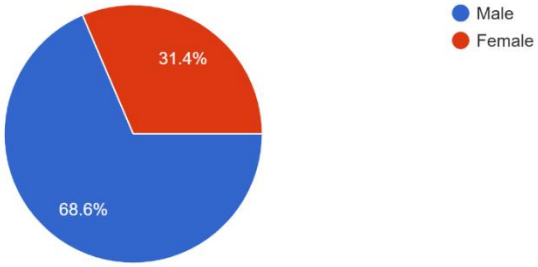

Figure 2. The characteristics of the respondents in terms of gender

Results and Discussion:

In the survey, the majority of the people asked for selected animal protein (63.5%), and the rest (36.5%) selected plant protein (Fig. 3). The animal protein industry will continue to expand as a result of the linked health advantages of eating meat. Dairy and other animal proteins also have a significant impact on demand via diet supplements and food consumption. However, plant proteins have been growing in the last few years and more people are consuming them.

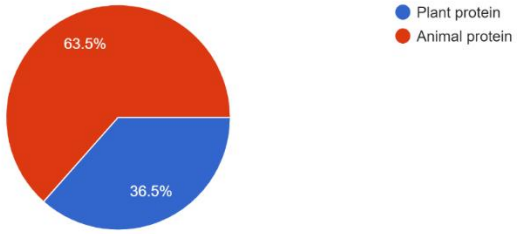

Figure 3. The answer of the respondents to the question: "Which source of protein do you consume regularly?"

Results show that most people (81%) do not calculate how much protein they consume each day, whereas the remaining (19%) will calculate their daily protein intake (Fig.4). Generally, people eat what they want and do not pay too much attention to exactly how much protein they eat.

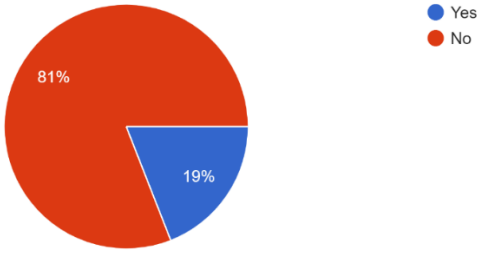

Figure 4. The answer of the respondents to the question: "Do you calculate how much protein you consume every day?"

People were asked to select their preferred plant and animal protein sources. Broccoli was chosen as a plant protein by 54.3% of participants, whereas Tofu, sprouted whole grain bread, Peanut butter powder, Oats, and Lentils were chosen by 35.2%. About 8.6% picked others, indicating that they consume additional plant proteins, and 1.9% chose none, indicating that they do not consume any of the plant proteins listed in the selection (Fig. 5). When it comes to animal protein, the majority picked eggs (62.9%), while the minority selected beef (3.8%). Others selected cheese (47.6 %), milk (43.8%), fish (41%), and kafir (39%). Chicken (32.4%), pork (28.6%), and others (2.9%) did not select any of the animal proteins listed (Fig. 6).

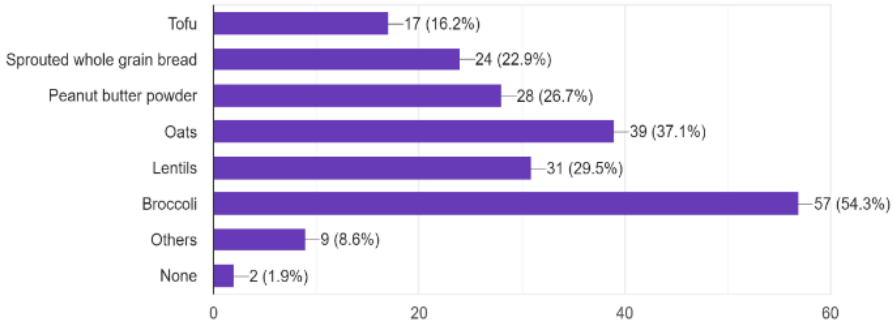

Figure 5. The answer of the respondents to the question: "What type of plant protein do you like to consume?"

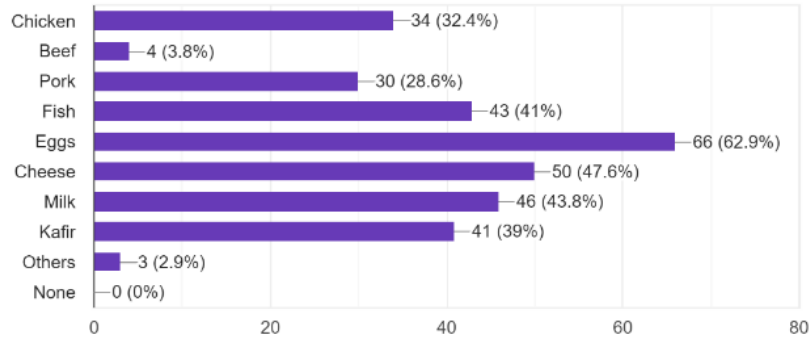

Figure 6. The answer of the respondents to the question: "What type of animal protein do you like to consume?"

Participants in the survey were asked how frequently they consume plant and animal protein. 50.5% of individuals eat plant protein every day because the body cannot store protein, any excess protein that is utilized for energy, or stored as fat once requirements are fulfilled, protein is required by our body to keep healthy and function properly [17]. 24.8% eat it a few times a week, 21% eat it once a week, and 3.7% eat it extremely infrequently (Fig. 7). Whereas 44.7% of adults eat animal protein a few times a week, 39.8% eat it once a week, 7.8% eat it every day, and 7.8% do not eat animal protein (Fig. 8).

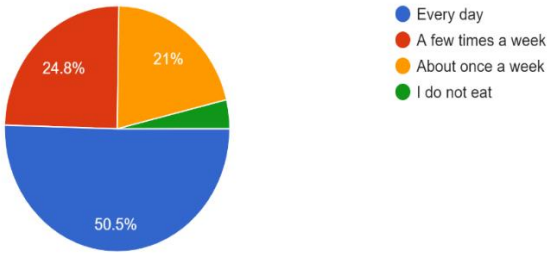

Figure 7. The answer of the respondents to the question: "In a regular week, how many times do you consume plant proteins?"

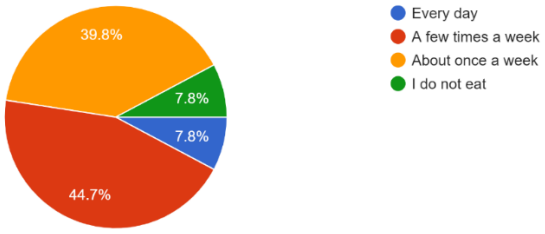

Figure 8. The answer of the respondents to the question: "In a regular week, how many times do you consume animal proteins?"

Moreover, people were asked how frequently they eat protein-rich meat substitutes. The majority of them eat it no more than once a month (35%). 22.3% eat a couple of times each month, 18.4% once every month, and 12.6% once per week. Few people (about 5.8%) would like to eat every day, or even a few times each week (Fig. 9). Economic development has a tremendous positive impact on human health and wellbeing, but it is also raising the need for protein-rich alternatives of meat. People tend to consume

more protein when they move into the middle class and obtain more spending power. One-third of individuals worldwide desire to eat protein-rich alternatives of meat [18].

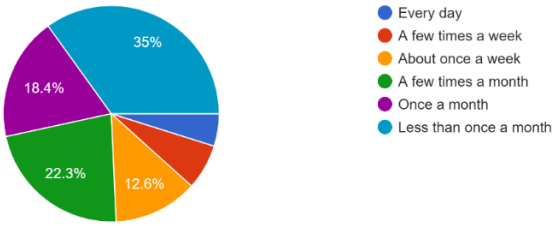

Figure 9. The answer of the respondents to the question: "How often do you eat protein-rich alternatives of meat?"

People were asked which protein source they thought was the best for them. The majority (68.6%) chose animal protein because the demand for animal protein is growing year after year. Others (31.4%) preferred plant protein (Fig.10).

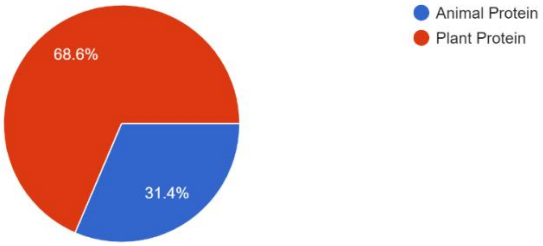

Figure 10. The answer of the respondents to the question: "What stands out as the best source of protein for you?"

The next inquiry was whether individuals eat plant-based protein-rich alternatives to meat. The majority of participants (87.4%) said no, while 12.6% said yes (Fig. 11). Many people do not consume protein-rich meat substitutes (produced from plants) owing to a lack of availability in their country or region.

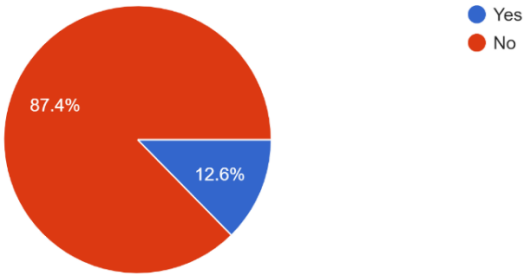

Figure 11. The answer of the respondents to the question: "Do you eat protein-rich alternatives of meat (made from plants)?"

The majority of surveyed people (53.4%) are not happy or satisfied with the variety of plant proteins available in mainstream supermarkets. Another 46.6% are satisfied (Fig.12). Plant-based food sales (the most common source of alternative protein) increased 17 percent in 2018 [19], and the usage of alternative protein as a food ingredient in consumer products is expected to increase further. Currently, the

market for alternative protein is worth around $2.2 billion, compared to a worldwide meat industry at over $1.7 trillion [20].

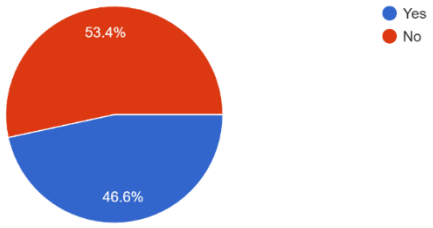

Figure 12. The answer of the respondents to the question: "Are you satisfied with the current variety of plant proteins available in mainstream supermarkets?"

People were asked if they had tried protein bars manufactured from insects. 89.4% answered no, while 10.6% answered yes (Fig.13). Many of them are not aware of insect bars or they are not completely knowledgeable about edible insects and their protein advantages. The primary reason that eating insects is regarded as a cultural taboo in Western countries is that insects are considered pests. There is such a fear of insects that no one would want them in the house or consume them.

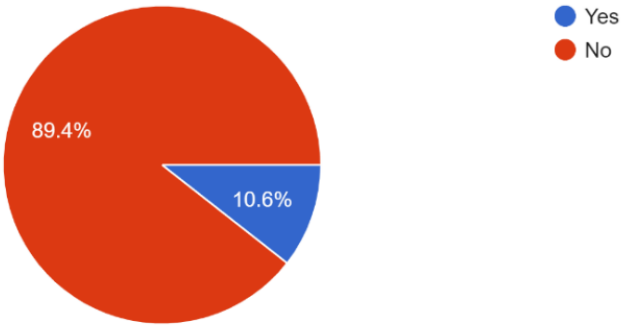

Figure 13. The answer of the respondents to the question: "Have you ever tried protein bars made from insects?"

Roasted, dried, and powdered edible insects are blended into a high protein, low-calorie flour. Beetles, locusts, crickets, and ants are the most common edible insects available for food on the market. Because of their compatibility with diverse natural ingredients and tastes, these powders are frequently utilized in the preparation of low-calorie energy bars and other products. 61.2% of them are not willing to consider eating a protein source derived from insects, 25.5% would like to try, and 13.3% answered yes (Fig.14). Furthermore, the ease of availability, protein extraction, excellent nutritional profile, and cost-effective processing techniques are making edible insects popular among customers, which is expected to drive market demand in upcoming years.

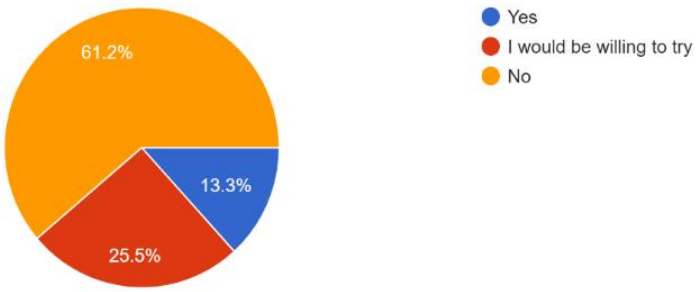

Figure 14. The answer of the respondents to the question: "Would you consider eating a protein source derived from insects? Please give a reason for your answer"

Most of the surveyed people (69.9%) prefer to use protein-rich food in their kitchen when they prepare meals and the rest (30.1%) prefer protein powder. Protein-rich food minimizes appetite and hunger Levels, tends to increase muscle mass and physical power, is useful for our bones, enhances metabolism and increases fat burning, reduces blood pressure, helps weight loss, doesn't really harm healthy kidneys, and helps our body repair itself after injury, aids us in staying fit as we age. Natural sources of protein include eggs, chicken breast, fish, beans, milk, cottage cheese, almonds, seeds, and whole grains [1][11]. Athletes prefer protein powder because they need extra protein and it is convenient. Some people have difficulty digesting protein powder. However, the majority of these adverse effects are caused by lactose intolerance [21].

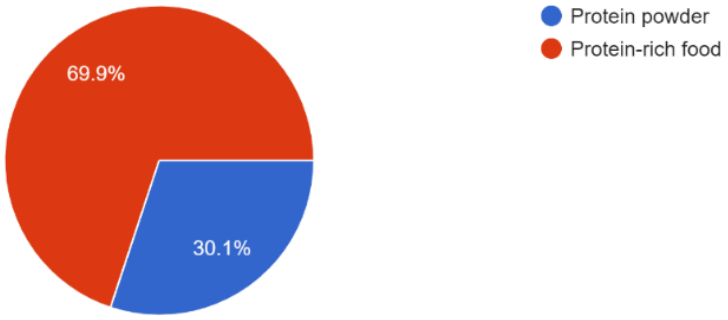

Figure 15. The answer of the respondents to the question: "What do you prefer to use in your kitchen when you prepare meals?"

Conclusion:

Global demand for protein is expected to continue to grow. Differences in protein quality and function still exist between animal and plant proteins. Science and technology involved in the supply chain of various protein products must keep pace with the exponentially increasing demand for protein sources. The growing demand for alternative proteins has led to rapid and impressive innovations in the food industry. It's not perfect yet, but perhaps it would help us direct our efforts toward improved nutrition labelling, reformulation of nutrient content, and greater consumer awareness of these types of products. The advantages of alternative proteins are obvious: lower carbon emissions, fewer concerns about the ethics and environmental impact of factory farming, and tasty, nutritious and healthy food.

Insects are nutritionally interesting material and can be counted among the commons. They can also be used as a dietary supplement for special diets, for example for athletes. The inclusion of potentially

suitable insect species in the regular diet requires defined and standardized conditions for their rearing, as well as detailed monitoring of their composition, including biologically active substances. Consumers are increasingly using alternative proteins in many world markets, with plant-based proteins expected to see the biggest increase.

Although alternative proteins currently represent only a modest portion of the market, they are experiencing a market growth rate twice that of conventional meat. However, some areas of the alternative protein market are performing better than others. Chilled alternatives are gaining popularity faster than frozen, and hybrids will account for a large portion of the alternative protein market for years to come. As more research is conducted, understanding will increase and consumer interest in alternative proteins is likely to increase.

This will also enable food scientists and technologists to actively contribute to the development of new products and to fill gaps in the appearance, texture, and quality of the eating experience of protein products. So, hopefully, alternative proteins could be part of the solution to the nutritional challenge of a rapidly growing population while offering flexibility in protein options.

From the conducted research it can be stated that:

1. Many people do not calculate their protein intake, only a few calculate their daily protein intake and know its importance. Protein is essential for all cells in our bodies. It promotes the growth of nails, hair, bones, and muscles.
2. People consume a wide range of plant and animal proteins. However, the majority of individuals prefer animal protein over plant protein. Animal proteins, including meat, eggs, and dairy, are great sources of protein, which means they include all of the necessary amino acids required by human bodies. The best protein sources are animal products.

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