NEW ERA AGRICULTURE MAGAZINE

Insect Protein – A Novel Protein Source and its Magnificent

Saurabh Singh[1]*, Arulkumar M[1], Mahendra Kumar[1], Sohan Lal Bajya[1], Gitanjali Kumari[2]

Introduction:

Insect proteins exhibit high amounts of high-quality proteins (50 to 80%) in terms of essential amino acid composition, total protein content, and nutritional value when compared to plant and meat proteins. In terms of nutrients, fat is the second largest nutrient in insects and its concentration increases during the larval stage of development. About 80% of it is made up of triacylglycerols and phospholipids making up to less than 20%, depending on the stage of life.

The characteristic, native protein structure, amino acids profile is different from plant protein and milk protein also. However, other factors, such as processing and chemical treatments, modifies the insect protein functionalities. Animal-based protein is well known that milk proteins fall into two different groups: casein micelles, which are frequently connected to the production of cheese, and serum proteins, which are involved in a wide range of beneficial properties like foaming, gelling, and emulsification. Additionally, egg proteins are separated into two groups: egg yolk proteins, which have a high lipoprotein content that makes them excellent emulsifiers. Food technologists can make the most of food proteins and minimize the loss of proteins as co-products, optimizing efficiency and advantages. The food industry has therefore recently become more interested in insect proteins because of their high percentage of protein (average 40% and up to 70% on a dry weight basis), mineral and vitamin contents, and attractive ratios of poly unsaturated to saturated fatty acid content. Additionally, edible insect proteins typically satisfy the WHO's essential amino acid content guidelines. Additionally, the average digestibility of insect proteins is between 76 to 98%, which is higher than that of plant-based proteins like peanuts and lentils (52%), and only slightly lower than that of animal-based proteins like beef and egg whites (100%). In addition to being environmentally sustainable, insect proteins have a high nutritional content and are easily digested and basically digestion depends on process modification. Insects are classified as food under the Federal Food, Drug, and Cosmetic Act if that is the intended usage.

Saurabh Singh[1], Arulkumar M[1], Mahendra Kumar[1], Sohan Lal Bajya[1], Gitanjali Kumari[2]*

[1] *Department of Dairy Technology, National Dairy Research Institute, Karnal, Haryana.*

[2] *Department of Dairy and Food Science Technology, Banaras Hindu University, Varanasi*

However, in order to be used in animal or pet food or for human consumption, insects must be prepared in accordance with the established guidelines. In this case, hygienic conditions (i.e., free from dirt, pathogens, and toxins) must be followed during production, packaging, storage, and transportation. They also need to be appropriately labelled with the insect's scientific name.

Nutritional characteristics of insects

Insect proteins are a strong contender as an alternative to conventional protein sources because of their high protein content, healthy fats, and profusion of vital vitamins and minerals. Insect Protein provides all necessary amino acids (20–76% of dry matter), lipids (2–50% of dry matter), chitin (2.7 mg–49.8 mg/ kg of fresh matter), and minerals including calcium, phosphorus, potassium, and magnesium. Insect protein digestibility are ranges from 86% to 90%. This is higher than many plant-based proteins, but lower than other animal proteins (egg, 95%; beef, 98%; casein, 99%).

Insects for human consumption

Around 1,900 species of edible insects have been identified as being consumed globally. Only a few numbers of edible bug species are being commercially raised for human consumption; the majority of edible insect species are grouped into eight categories. With 350,000 species of beetles, the order Coleoptera is the biggest animal order on Earth; 659 of these species are mainly eaten when still in the larval stage of development. The order of insects recognized by many common names, such as locusts, grasshoppers, and crickets, is called Orthoptera. The fact that these insects are well-known in Western culture has played a significant role in introducing insects for human food to the Western market. The primary insect species that are regarded as completely domesticated include bees, silkworms, house crickets, and cochineals. However, house crickets (A. domesticus), tropical banded crickets (G. sigillatus), and yellow mealworms (T. molitor) are the most

Table 1. Insects and its nutritional characteristics

Insect	% Protein	% Fat	% Fiber
Termites and cockroaches	35.3	29.2	5.3
Grubs, beetles	40.7	33.4	10.7
Flies	49.5	22.8	13.6
Cicadas, stink bugs	48.3	30.3	12.4
Bees, wasps, ants	46.5	25.1	5.7
Butterflies, moths	45.4	27.2	6.6
Dragonflies, damselflies	55.2	19.8	11.8
Grasshoppers, locusts, crickets	61.3	13.4	9.6

commonly farmed insects for human food globally due to their recent successes in commercial raising.

Processing of insect protein and application in food industry

Insects that are considered edible are normally eaten intact and easily identified as such; but, when eating insects raw, it may be necessary to remove certain unappealing body parts, such as the legs, wings, head, antennae, and guts. A number of processing methods have been employed to enhance the harmless ingestion of insects and raise their acceptability (i.e., get over the yuck factor). While the quantity of these procedures that are currently in use varies greatly, the fundamental functions consist of cleaning, heating, and drying.

Insect euthanasia is typically carried out by either heating (blanching for 5-7 minutes at 80–100 °C) or lowering the temperature (freezing for 24 hours at −18 °C). However, other techniques, including asphyxiation, microwaving, pithing, and the use of infrared tunnels, have also been documented. After that, the indigestible portions of the insect are divided by, for example, shaving off the hard hairs and spiky areas to lessen the chance of intestinal constipation and prevent uncomfortable oral sensations. Freezing can make it easier to remove some body parts during the slaughtering process. Moreover, because the insect's intestines contain diseases and germs that cause spoiling, it could also need to be removed. Since the gut of the majority of edible insects cannot be entirely removed, a fasting stage (about 24 hours) may be used to lower the amount of these gut-dwelling microbes. Cooked insects are frequently eaten in ready-to-eat meals or as roasted or fried snacks. As a result, a few common heat-processing techniques have been used, such as steaming, boiling (blanching), roasting, deep-frying, smoking, stewing, and/or combining these techniques. It is well established that processing techniques deactivate enzymes and improve the nutritional value, palatability, and digestibility of insects. For example, water, chemical solvents, and enzymes can all be used to extract proteins. The kind of insect, type of solvent, drying method, and/or temperature of the extraction all affect the rate of extraction as well as the physicochemical, functional, and bioactive characteristics of the proteins that are extracted. A variety of techniques, such as enzyme-assisted extraction, reverse micelle precipitation, two-phase aqueous extraction, electrodialysis ultrafiltration, ultrasound-assisted extraction, supercritical CO2 extraction, high pressure, and alkaline extraction followed by isoelectric precipitation, are used to produce protein concentrates (65–90% protein dry basis) or

isolates (>90% dry basis) from extracted proteins.

Concerns of safety and regulation related to the use of insect protein

In order for edible insects to be included in the global food market, safety concerns and legislative limitations (such as standards, labelling, and other regulatory tools) must be taken into account. In Western nations, insects were not seen as food or a source of sustenance until a few years ago. For instance, edible insects were categorized as "impurities" by the Codex Alimentarius, one of the major agencies that oversees the international trade in food and animal products. Food Safety Modernization Act (FSMA) enacted in the United States established the Preventative Controls for Human Food (PCHF) rule, which means that edible insects will be governed by the FDA. Insect farms are exempt from this Act unless they turn the raw agricultural products into processed foods. The US Food, Drug and Cosmetic Act stipulates that "insects are considered food if that is the intended use". A good manufacturing practice certification and the necessary microbiological testing must be attached to edible insect farms. Additionally, since there is strong evidence that people who are allergic to shellfish may also be allergic to insects, allergen-warning labels must be placed on foods that contain insects in the United States. There is a global trend of eating insects, which are either eaten whole or included in a variety of food products in many Asian, African, and South American nations. The microbial load and antinutritive content of edible insects can be reduced by popular preservation techniques (such as heat treatments) utilized during cooking or processing.

Conclusion

Insect protein is rapidly gaining recognition as a novel and sustainable alternative to traditional protein sources, offering numerous nutritional, environmental, and functional benefits. With high-quality protein content, essential amino acids, healthy fats, and vital minerals, insect protein stands out as a highly nutritious food ingredient. Its environmental sustainability, marked by lower resource usage and reduced greenhouse gas emissions, further enhances its appeal in a world facing increasing challenges related to food security and environmental sustainability. Despite the promising attributes of insect protein, there are challenges to its widespread adoption, particularly in terms of consumer acceptance and regulatory concerns. Cultural perceptions and the unfamiliar taste and texture of insects can be barriers to acceptance. However, innovative processing methods that transform insects into more familiar forms,

such as protein powders and meat substitutes, can help overcome these obstacles.