Global Perspective of Edible Insects as Human Food

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ABSTRACT

We have reviewed current information on edible insect uses as a human food worldwide with the perspective of nutritional value, commercialization of insect as foods, economics of meat production, problems regarding the entomophagy, and further area of improvement. From this review, we could suggest that the entomophagy could be a potential alternative to poverty improvement.

Key words: Insect industry law, Entomophagy, Efficiency, Nutritional value, Food security

INTRODUCTION

In Korea, insect industry law was effective since 2010 (MOLEG, 2010). Increasing attention is given to the use of insect as new protein source. The practice of eating insects as a food is known as entomophagy. The practice of eating insects goes back thousands of years and has been documented in nearly every part of the world. In modern times, however, consumption of insects has declined in many societies and is sometimes ridiculed as old-fashioned and unhealthy. Yet, it would be prudent to carefully consider the value of customary knowledge before discarding it too readily. Scientific analysis confirms, for example, the exceptional nutritional benefits of many forest insects, and studies point to the potential to produce insects for food with far fewer negative environmental impacts than for many mainstream foods consumed today. Aside from their nutritional and environmental benefits, experts see considerable opportunity for edible insects to provide income and jobs for rural people who capture, rear, process, and transport and market insects as food. These prospects can be enhanced through promotion and adoption of modern food technology standards to ensure that the insects are safe and attractive for human consumption. Traditionally, most edible insects have been harvested from nature, but surprisingly little is known about the life cycles, population dynamics, commercial and management potential of most edible insects. Among forest managers, knowledge and appreciation of how to manage and harvest insects sustainably is limited. Worldwide, nearly 1700 insect species are reported to be used as human food. Four insect orders predominate, in rank sequence: Coleoptera, Hymenoptera, Orthoptera and Lepidoptera, accounting for 80 percent of the species eaten. Edible insects represent rich sources of protein for improvement of the human diet, especially for individuals suffering from poor nutrition because of a protein deficit. Gram for gram, insects often contains more protein and minerals than meat. In fact, nutritionists represent the leading group of researchers in food insects, motivated by a desire to remedy the problems associated with protein deficient diets (Johnson, 2010). Insects are an important natural resource, both for self-sufficiency and as commercial food products in many parts of the world. This report provides the information about the importance of edible insects in global market.
**METHODOLOGY**

Data on edible insects were collected from the secondary source as well as by primary source. The secondary source has been taken from the published papers, annual reports, survey reports and different books on edible insects and the primary source are by personal contacts with the Korean mass rearing industries and also the Korean restaurant basically selling the edible insects of edible insects.

**RESULTS AND DISCUSSION**

Nutritional value of edible insects

Edible insects have significant roles in providing food and they are vital dietary elements providing nutrients of high biological value including energy. For every 100 grams of dried caterpillars, there are about 53 grams of protein, 15% of fat and 17% of carbohydrates with 430 kilocalories. This showed a higher proportion of protein and fat than beef or fish, with a high energy value. Ramos-Elorduy and co-workers (1997) analysed several insects that are currently eaten. The conclusion was that the species provide high-quality proteins and supplement the diet significantly with minerals and vitamins that are often in short supply in developing countries. In general the protein content of insects ranges from 40 to 75 g/100 g dry weight, which is comparable to the protein content of meat (Bukkens, 1997; Ramos-Elorduy et al., 1997). Most insect species convert plant protein to insect protein very efficiently. DeFoliart (1992) estimated that the food conversion efficiency of crickets is more than five times that of beef. Table 1 provides information on the nutritional value of edible insects.

The quality of the protein, and thus the nutritional value, is determined by the amino acid composition and the digestibility of the proteins (Ladron de Guevara et al., 1995).

Most insects contain sufficient amino acids to fulfill the nutritional requirements. The essential amino acid content score of insects ranges from 46 to 96% (Ramos-Elorduy et al., 1997). The first limiting essential amino acid in the majority of insects is either tryptophan or lysine (Bukkens, 1997; Ramos-Elorduy et al., 1997). The protein digestibility of insect protein is high, 77 to 98% (Ramos-Elorduy et al., 1997). The values for insects with an exoskeleton are on the lower level, due to chitin. If the outer skeleton is removed the digestibility increases and is comparable to meat (DeFoliart, 1992). Insects vary widely in fat content and thus energy. The fat content of insects ranges between 7 and 77 g/100 g dry weight and the caloric value of insects varies between 293 and 762 kcal/100 g (Ramos-Elorduy et al., 1997). These values depend on the diet of insects and insect species. For instance, worms, caterpillars, and termites are known to contain more fat (Bukkens, 1997). The fatty acids in insects are similar to those in poultry and fish. According to DeFoliart (1992) some insects contain more essential fatty acids, like linoleic and/or linolenic acids, compared with meat. Overall the mineral content of insects ranges from 3 to 8 g/100 g dried sample (Ramos-Elorduy et al., 1997). They contain a high amount of zinc and iron (DeFoliart, 1992), which is more than beef (Bukkens, 1997). The calcium concentration is around 920 mg/100 g dry weight (Bukkens, 1997). In conclusion, insects contain high-quality proteins and supplement the diet significantly with minerals. Besides, they have a long history of safe consumption. However, there are some disadvantages with regard to the production of insects as food. As mentioned before, the composition, and thus the nutritional value, of insects varies. Furthermore, the scaling up of insect breeding can be difficult. Not all species are suitable to culture at a large scale (DeFoliart, 1999). Some of the problems of breeding cattle may also occur at the insect farms, like increasing vulnerability to diseases and animal welfare. Another problem is the fact that insects can produce defensive secretions and/or can be a source of inhalant allergens (e.g., cast skins, excreta), which might be irritating for people working with them (DeFoliart, 1992).

**Insects that are commonly eaten in the world**

Over 1900 species are listed as edible (Mitsuhashi, 2008). Over 1500 species of insects are known to be consumed by humans from over 300 ethnic groups in 113 countries (MacEvilly, 2000). The commonly eaten insects are followed: The Grasshoppers; locusts, crickets, caterpillars, beetles (both young one and adults); alatte termites, queen termite, bees (both brood and pupae); ants, cicadas, variety of aquatic insects and their eggs; (insect caviars), some moths and their cocoons and many other insects.

**Korea:** Eating insects is not common in these days but old

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Table 1. Nutritional value of insects (g/100 g dry weight) derived from Bukkens (1997) and Ramos-Elorduy et al. (1997)

<table>
<thead>
<tr>
<th>Insect Order</th>
<th>Protein</th>
<th>Fat</th>
<th>Carbohydrate</th>
<th>Kcal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthoptera</td>
<td>66-77</td>
<td>4-7</td>
<td>13-33</td>
<td>362-427</td>
</tr>
<tr>
<td>Coleoptera</td>
<td>21-54</td>
<td>18-52</td>
<td>7-42</td>
<td>410-574</td>
</tr>
<tr>
<td>Lepidoptera</td>
<td>15-60</td>
<td>7-77</td>
<td>3-58</td>
<td>293-762</td>
</tr>
<tr>
<td>Hymenoptera</td>
<td>1-81</td>
<td>4-62</td>
<td>9-93</td>
<td>416-655</td>
</tr>
<tr>
<td>Mean</td>
<td>45-55</td>
<td>40-57</td>
<td>0-1.5</td>
<td>433-652</td>
</tr>
</tbody>
</table>