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MUSEU PARAENSE EMÍLIO GOELDI

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Volume 1

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INSECTS AS FOOD IN INDIGENOUS POPULATIONS

Gene DeFoliart[1]

Worldwide, more than 500 species of insects have been reportedly used as food by humans, mostly in tropical and subtropical regions. Representatives of all of the major insect orders and many of the minor ones are included. For insects such as beetles, bees and moths, which have four life stages, it is usually the larval stage that is harvested, although pupae are sometimes used, and, in the case of beetles, even the adults after removing the hard parts. For insects having only three life stages, such as water-bugs, cicadas and grass-hoppers, either the nymph or adult, or both, may be consumed. Most insects are fried or roasted, but sometimes they are eaten raw or prepared as relishes or prepared in other ways.

Numerous biochemical analyses have shown insects to be high in crude protein, frequently ranging up to 60% or more an a dry weight basis. Not so well known is the fact that insects are also high in fat (and therefore energy), and high in many of the vitamins and minerals. Quite representative are data by Oliveira et al (1976) which show the nutrient content of four species cooked according to traditional methods in the central part of Angola. The four species analyzed included a termite, *Macrotermes subhyalinus*; two saturniid caterpillars, *Imbrasia ertli* and *Usta terpsichore*; and the larva of the palm weevil, *Rhynchophorus phoenicis*, all of which are common in Angola and widely distributed in the Ethiopian faunal region. Expressed as a percentage of the recommended daily allowance (F.A.O. 1973) obtained in 100 grams (g) (or 3.5 ounces) of insect as consumed, the termite and weevil were shown to provide 21.5% and 19.7%, respectively, of the daily requirement for calories. These high energy values reflect their high fat content. Compared to corn, which provides about 320-340 kcal/1000 g, these two insects provide 613 and 561 kcal/100 g, respectively. The saturniid caterpillar proved of exceptional nutritional value, 100 g providing 76% of the daily protein requirement (biological value, not crude protein), and more than 100% of the daily requirement for many of the vitamins and minerals, i.e., iron (197%), copper (120%), zinc (153%), thiamine (245%), and riboflavin (112%). The weevil was also high in zinc, thiamine and riboflavin, and fairly high in iron.

Considering their traditional use in many areas and their apparently pretty good all-around nutritional value, it is not surprising that a number of

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investigators who have worked among indigenous populations have called for, or implied the need for, greater government recognition of these traditional foods, e.g., Quin (1959) in South Africa, Meyer-Rochow (1973) in Papua New Guinea, Chavunduka (1975) in Zimbabwe, Conconi (1982) in Mexico, Gope and Prasad (1983) is eastern India, and Dufour (1987) in Southeastern Colombia. In view of this, it seems that edible insects should be getting more attention as one of the resources available for greater exploitation in attempting to alleviate hunger and malnutrition. Because, for all practical purposes, they are never mentioned in this context in the United States, we organized in 1986 what is called the Food Insects Research and Development Project (FIRDP) at the University of Wisconsin. The first objective was to determine whether the use of insects as food continues to be wide-spread or is rapidly declining in the face of acculturation toward western attitudes and/or because of ecological factors. Contacts with a number of people who are knowledgeable about the currently existing situation and future potential of insect foods in particular localities confirmed that edible insects are still extensively used throughout the tropical world, and that they could probably make an even greater contribution to human nutrition if supplies were increased or better distributed seasonally (DeFoliart, 1989).

As a result of these responses and a variety of other inputs, a second objective of the FIRDP is to: Build a greater awareness among North American food and agricultural scientists, government agencies, and the public-at-large of the nutritional importance of edible insects among rural populations in the developing world. To support this advocacy role, we are currently developing up-to-date inventories on the use of insects as food and/or animal feed in more than 50 countries. These inventories serve as an informational base for occasional press release, seminars presented to various types of audiences, and a 1-credit course, "The Human Use of Insects as Food and as Animal Feed," which was offered for the first time during the 1988 spring semester at the University of Wisconsin.

A third objective is to: Help build a stronger global voice of advocacy by establishing better communication and mutual support among scientists and others who are interested in maximizing the nutritional contribution of indigenous edible insects in those countries where their use is culturally traditional. An internationally distributed newsletter initiated in July, 1988, should help to facilitate information exchange.

If insects are to make a greater contribution to human nutrition, much more research is needed. Better information, applicable to specific localities, is needed on such things as: 1) Taxonomic identity of the edible, traditionally used, insects, 2) Seasonal occurrence and complementarity with other foods, 3) Quantitative use and patterns of use, 4)Possibilities for expanding urban and export markets, thus improving rural economies, 5) Development of more efficient methods of harvesting natural populations, and/or small-or-large-scale mass-production systems, and 6) Possibilities of integrating food insect harvest with pest control objectives.

Taxonomic problems relative to food insects are at two levels: 1)There has been essentially no taxonomic input in some countries, and 2)In others, despite expert taxonomic assistance, many of the collected specimens cannot be identified to species. The latter simply reflects the poor state of insect taxonomy in general in the tropics and the need for basic taxonomic research in the tropics. Colombia can be used to illustrate both aspects of the problem. Prior to 1973, three investigators had mentioned the consumption of insects by the Yukpa, but fewer than a dozen species were indicated, and the specific identity of only one. This is typical of the current state of knowledge in many, many countries, and it is, of course, impossible to conduct further studies of any kind on a taxonomic foundation such as this.

Results are now available from two more recent and excellent studies in Colombia, the first by Ruddle (1973) on the Yukpa in the northeast, the second by Dufour (1987) on the Tukanoans in the southeast. Ruddle's material was studied by taxonomists at the U.S. Department of Agriculture's Insect Identification Laboratory at Beltsville, Maryland, and suggested that at least 25 species are included in the Yukpa diet, but only 13 could be identified at the species level, 10 more at the generic level, and two only at the subfamily level. Nevertheless, Ruddle's work was enough to place Colombia among the five or six "best-studied" countries insofar as food insect use is concerned.

Dufour (1987) reported that at least 20 species are used by the Tukanoans in southeastern Colombia. This material was also examined by experts at Beltsville, but only 11 identifications could be made at the species level, two at the generic level, and for six species the genus could not be determined from the material examined. It is of interest, aside from the taxonomic difficulties, that there was virtually no overlap in species reported from the two different localities in Colombia. The only exception was that the *Atta* ssp. (leafcutter ants) reported by Ruddle undoubtedly included one or more of the three species of *Atta* reported by Dufour. There was no overlap in the Coleoptera, or beetles, reported, and little or no overlap in the caterpillars used. Ruddle found seven or more species of grasshoppers used by the Yukpa, while Dufour did not observe grasshopper use by the Tukanoans. Ruddle reported insects from three orders, but no termites, while Dufour observed the use of three species of termites. These results suggest that, in the few and widely scattered studies conducted to date, we have barely scratched the surface in determining the number and variety of insects used as food.

Zaire, in central Africa, is also an example of what strong taxonomic work can reveal. Bequaert (1921) and other early observers provided information on 14 species used as food, including six species of caterpillars, but Malaisse and Parent (1980), in a careful study restricted to the southern part of the country, and only to caterpillars, identified at least 35 species that are used, including 21 in the family Saturniidae (the giant silkmoths). They also reported the duration of the season when each of these caterpillars occurs. Seasonal occurrence will be important in planning strategies whereby insect foods can be made available the year-around.

One other country that must be mentioned relative to progress in the taxonomic identity of the insect species used as food is Mexico. Prior to studies initiated in the mid-1970's by Dr. Julieta Ramos-Elorduy de Conconi, fewer than 20 species had been reported as food. Conconi et al. (1984) reported 101 species, and the total know now is more than 200 (Conconi, pers. comm. 1986).

More studies are needed, similar to the one by Richards (1939, pp.37-42) on the Bemba of Zambia, showing the seasonal availability of edible insects in relation to vegetable and other animal foods. Her data from 1939 may no longer be entirely applicable, but they make the point. They show that caterpillars were the only major source of animal proteins during the so-called "hunger months" of December and January. Thus, research aimed at increasing the efficiency of the caterpillar harvest from nature or the development of simple methods of small- or large-scale mass culture would appear warranted.

Unfortunately, Richards did not know, or did not divulge the specific identities of the caterpillars in Zambia. In order to target the best candidates, biologically, for development, again, taxonomic identity is needed. The seasonal data of Malaisse and Parent (1980) reveal that 20 of the 35 species they studied in Zaire are available only in March and April. A total of 29 and 32 species are harvestable during those two months, respectively, which corresponds with the "late rains" in southern Zaire. Fewer species are available for harvest in other months, and none from November through January, which, however, is the period of heavy harvest in neighboring Zambia. Other studies indicate that the season of maximum caterpillar harvest varies considerably from region to region. If research can develop methods of increased production or prolonged storage quality of some of these species, seasonal availability in the countries of central and southern Africa could potentially be prolonged through establishment of interregional trade. At least one species, *Gonimbrasia belina*, is already the subject of such commercialization and trade involving Botswana, South Africa, Zimbabwe and Zambia. According to Dreyer and Wehmeyer (1982), the South African Bureau of Standards estimated annual sales through cooperative markets at 1600 metric tons in that country.

Good data on quantitative use of food insects are almost non-existent, and they are very difficult to obtain, as has been pointed out by Posey (1978, 1987), and others. The most recent data are those of Dufour (1987), in Colombia estimating that insects furnished 12% and 26% of the animal proteins in men's and women's diets, respectively, during the months of May-June, and approximately 5-7% for the year as a whole. Insect consumption was inversely related to the availability of fish and game. Insects are an important source of fat in the diet of Tukanoans, and also of protein value in that the amino acid composition is complementary to that of dietary staple, cassava, which is limited in lysine and threonine.

The most comprehensive study on quantitative use was that of Gomez et al. (1961), estimating that insects furnished 10% of the animal proteins produced annually in Zaire, compared to 30% for game, 47% for fishing, only 01% for fish culture, and 10% for grazing animals and 02% for poultry. This

10% for Zaire as whole becomes more impressive when the data are broken down into the country's 25 districts and 137 territories. For example, in Kwanga District which is divided into five territories, insects furnished 37% of the animal proteins for the district as a whole and from 22% to 64% in the different territories. Totally, in the country, insects furnished more than 20% of the animal proteins produced in four of the districts and in 32 of the territories.

It is interesting, and revealing I think, that in projecting the country's future protein needs and how they might be met, Gomez et al. considered possible increases in fish culture, grazing animals, and poultry, but assumed that the insect contribution would remain only at then-current levels. There is reason to believe that the quantitative use of insects as estimated for Zaire is not atypical of other countries of south and central Africa. From a standpoint of ecological compatibility and sustainable agriculture, research aimed at increasing the supply of food insects would seem to make much more sense than continuing to bring down the forest for cattle production.

Edible insects are a prominent item in the village markets of the developing world. The variety is great, in southern Mexico, for example, including grasshoppers of the genus *Sphenarium*; "jumiles" bugs (several species of pentatomids); fried "chicatana" (leafcutter ants); "escamoles", (the larvae and pupae of the ant, *Liometopum apiculatum*, sometimes referred to erroneously as "ant eggs"), and "ahuahutle" or "Mexican caviar (eggs of several species of aquatic Hemiptera), among others. It's the same in may of the rural areas of central and southern Africa, southern and southeastern Asia, and parts of northern South America. Only the species which are used changes from locality to locality. Indigenous peoples eat their traditional insect foods because they like them, not because they have to, not just to ward off starvation. According to Quin (1959, p. 234), the Pedi of South Africa preferred many of their insect relishes to beef; according to Ruddle (1973), the same is true of the Yukpa of Colombia-Venezuela.

Inasmuch as some of these insect species appear not only in the rural markets, but on the menus of the finest restaurants in the large cities, research aimed at increasing supplies and providing more "respectability" for these traditional foods could contribute not only to directly improving rural nutrition, but also to improving rural economies.

ABSTRACT: Edible insects are extensively used as food among indigenous rural populations in tropical and subtropical countries. There is reason to believe that the nutritional contribution of insects and their potential as a useful resource in helping to alleviate problems of hunger and malnutrition should be receiving more attention from national and international government agencies and from food and agricultural scientists.

KEY WORDS: Indians, Insect Eating, Entomophagy, Human Nutrition.

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