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RESEARCH CENTER

The Edible Insects project

Feeding the planet with
new sustainable sources



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THE EDIBLE INSECTS PROJECT

Executive summary

The necessity to guarantee food security to an always growing global population, that by 2050 is estimated to be greater than 9 Billion people, has driven with increasing interest to insect use as a protein source for humans¹ and animal feed².

The Edible Insects project wants to assert that consumption and breeding of edible insects represents one of the necessary ways to secure an increase in global food production in a sustainable way.

The complexity and ever-growing quantity of scientific informations offers us a great indication of the importance of this theme in recent fields of study.

Another relevant aspect that can be deduced is that there is a scarce level of in-depth analysis on the subject by the Italian political class. The importance of this theme has been underestimated by putting it in second place, with the evident risk of losing the opportunity to promote specific scientific R&D - despite important national projects are already in place - and moreover, losing the opportunity of being leaders at an international level of a project - slow but unstoppable - already in place as part of a shared sustainability program.

Thematic areas have been identified and a trial was launched in which groups of experts from different public entities (universities and R&D centres across Italy) and private organisations committed to analyse current research and system state of the art, flaws and opportunities with the aim to propose effective research guides lines.

THEMATIC AREAS

1-Feed the planet in a sustainable way.

To understand cultural and socio-economic aspects of the sustainable production and consumption of insects in different realities.

To create replicable best practices finalised to generate the conditions for a future food self-sufficiency of the beneficiary. To start-up micro insect breeding farms for “family” use in the geographical areas where food is not available (more importantly, where proteins are scarce) for the poorer population, making sure to select the most suitable edible insect species, carry out formation activities for the population and set up small centres for the transformation and production of protein flour for human nutrition and livestock feed.

In countries where insects are regularly consumed the choice of eating insects is not due to the fact that they are protein-based or sustainable, but more to the fact that they taste good. At the moment the highly industrialised continents are the ones where human entomophagy is considered a taboo. However, this lack of acceptance can't be a barrier to continents where entomophagy was or still is part of a normal diet. Both philosophy and human sciences can be the key to deal with this subject in a pragmatic way. To prove this matter we consider the studies of psychologist Rozin and collaborators about the evolutionary and moral sense of aversion.

¹ FAO 2011a. *World Livestock 2011 - Livestock in food security*. Rome, FAO.

² Makkar, H.P., Tran, G., Heuzé, V., & Ankers, P. 2014. *State-of-the-art on use of insects as animal feed*. *Animal Feed Science and Technology* 197: 1-33.

Socially and culturally, aversion involve principles, beliefs, prejudices, habits but also obsessions and fanaticisms when consolidated. The motivations that induce us to embrace and sustain the principles of sustainability can be varied. Aside from motivations that are at the basis of a sustainability route, each step taken in this direction gives us benefits in both “small scale” like family-business and in terms of larger scale to the whole of society.

The important thing is setting on the road for improvement: a road that must be continuous with time and guarantee the rights to access food.

2-Edible Insects Breeding: Research, Opportunity and Caution.

To fully understand the aspects linked to opportunities, research results and precautions.

The European food industry and in particular the Italian one can guarantee a certified use of products derived from insects, bred and fed with standard-quality food to support a growing demand of national or foreign insect based food destined for human consumption. Also, the European animal feed industry represents approx 15% of the global market with its estimates 153 million ton per year⁴.

The strategic supply of proteins is crucial and partly compensated by soya, whose production in Europe is not sufficient and generally not sustainable. So why not produce more protein sources in Europe? To develop eco-sustainable food and animal feeds, scientific research has to move towards innovative protein alternatives, capable of accenting biodiversity and guaranteeing sustainability of both land and sea animal products. FAO states that part of the solution to this problem could reside in the use of insects as raw material for human nutrition and for the preparation of livestock feed.

To evaluate the aspects linked to the opportunity and use of insects in different industrial branches; in particular the textile branch (traditional and wild silk production chains), the bio-refinery branch (bio-conversion of organic waste and extraction of fats for the production of bio fuel), the biomedical and cosmetic branch (chitin derivatives, silk biopolymers for the production of biomaterials and cosmetics and extraction of antimicrobial peptides). Considering the interest recorded on this matter, the state of research about insects used in the “non-food” and “non-feed” industry, shows a wide spectrum of possible scenarios that could, most likely, be growingly present in the near future.

3-Dietary and nutritional aspects.

To evaluate the adequacy and the practice of a given diet that includes insects as a protein source in populations that traditionally use them as food.

As highlighted in FAO's report “Forest products critical to fight hunger - including insects - New study highlights role of insect for food and feed consumption” the human population that currently eats insects is estimated at around 2 billion people in over 90 countries. Usually, nutritional values of these populations are unknown as they are characterised by destitution and food poverty for endemic environment, social, cultural and geo-political reasons. Hunger, which afflicts 1/5th of the population of developing countries, is a great obstacle to the progress of people and society. Without the right action, malnutrition with its deaths and consequent diseases, will be passed on from one generation to the next.

³ Rozin, P., Haidt, J., & McCauley, C. R. (2008). *Disgust*. In M. Lewis & J. Haviland (eds.), *Handbook of emotions, third edition* (pp. 757-776). New York: Guilford. (First edition published in 1993).

⁴ AllAboutFeed magazine no. 3, 2015

Nevertheless the numerous areas involved are currently facing a demographic and economical growth based on a model that introduced numerous risk factors, that goes beyond economical aspects and causes numerous health problems to those who eats too little (malnourishment), too much (excessive nutrition) or follows an unbalanced diet, without the nutritional substances necessary for a healthy lifestyle (micronutrient deficiency).

To understand and evaluate the role played by the transformation of both industrial and household processes on the nutritional value of foods. Some of these modifications occur also because of the edible insect matrix: actually, a great part of commercially available insects are processed per extraction, desiccation, heat or fried.

To evaluate and understand the role of transformation processes a multidisciplinary approach is necessary to be able to monitor the nutritional value modifications and the food matrix at the chemical level, but also determine the drawbacks that these given modifications can have on a biological system.

4-Legislation and Risk Assessment.

At the moment the authorities that look after food security and legislators are in a peculiar position.

On one hand they see the necessity to have valid scientific evidence available to define the potential risks and on the other they are urged by economical operators and potential consumers that believe that the normative-technical delays are useless obstacles to the diffusion of a certain healthy, ecological and already available food practice.

The identification of possible dangers due to insect consumption becomes fundamental to guarantee both consumer safety and the possibility for the food industry operators to have a transparent normative context available that can guarantee the correctness of their activity.

5-Communication and information.

To understand the reasons that interfere with a change in nutritional behaviour of western culture towards eating food originating from alternative, innovative and more sustainable sources than the current ones, like edible insects.

It's also necessary to understand which strategy, incentive, approach, bearing put in place to promote a less impactful way of life than the current one, for the sake of the planet's more finite and precious resources.

To collect the analysis data used in social sciences to evaluate the consumer's approach towards new and more sustainable food sources like edible insects and describe what emerges from researching index data banks and the web on how to facilitate or promote a dialogue on such an innovative theme to positively influence the consumer's awareness.

ACTIONS AND OPPORTUNITIES DERIVED FROM THE ANALYSIS.

Insects alone won't solve the problems linked to rights and food access but have a great potential to contribute to global food safety.

- Insects are an important alternative source of proteins and nutrients that can contribute to an improvement in food and nutritional safety for the poorer and disadvantaged areas of the planet. The lack of pragmatic projects are highlighted beginning from the real situation analysis which allows the triggering of social and cultural processes and raises awareness towards this important resource and therefore the empowerment and activation of local population at different levels, like professional operators (farmers, and merchants), families (especially mothers who are responsible for their child's nutrition), cultural institutions (schools, universities...).

The involvement of NGOs and other great humanitarian organisations spread throughout the world could contribute in filling these gaps and promote micro-breeders so that they can, in time, manage autonomously their edible insects breeding farms for commercial and private use.

- These important alternative sources of protein, like raw materials for the composition of livestock feed, could have a market similar to the one of fish meal and soya which are currently the main components used in animal feed formulas destined for breeding farms and aquaculture thus notably saving energy and space and limiting the non-European market's industrial dependency. The low growth times and the high conversion efficiency of animal proteins to food would greatly reduce the impact on agricultural ecosystem, better preserving resources. In the world and in particular in Europe, the number of young start-ups and businesses are increasing and in this "small resource" they have found a concrete possibility for production in a more sustainable way, paying more and more attention to the different aspects linked to recycling production waste.

- Important alternative sources of protein, insects could contribute in cutting down infant undernourishment and malnourishment problems in some countries, if employed as Therapeutic Food. Food design and its layout don't refer only to the food design but also to the context they belong to. The necessity to re-evaluate and promote the concept of food design now emerges, not as mere planning of curious dishes for Europeans but as analysis of nutritional needs as a link between different areas of interest.

- However, the absence of data on food safety directly reflects food legislation which does not define foods as such based on their nutritional characteristics, but on the basis of their consumption and associates the fact that these don't cause any risk for human health. The problems associated to these insect-based foods make it appropriate to create a special legislation for these products: either specific guidelines (like for vegetable sprouts) or by modifying current guidelines that limit this particular food product.

- Between the most important knowledge gaps are conservation aspects: i.e. the consequences of pulling out species in the wild, the risk of introduction of allochthonous species, of genetic contamination of animal populations. Actually there is to scarce literature about the potential impact on the environment of the breeding of insects, either on a small-scale or at industrial level. This lack of studies is a limit that must be dealt with and sorted in a short time, assigning proper dedicated resources before it happens that organized large-scale breeding programs produce alarms on different levels, mostly environmental, issues that would need to be solved in emergency notwithstanding pure economic considerations. Few studies are specifically directed to the evaluation of environmental performance of breeding of insects, despite the related benefits.

- The “biotic dimension” of the assessment on the environmental impact of the production process requires a considerable effort to adapt the general conceptual approach “Life Cycle Assessment” (LCA) to the specific complexity of ecological relationships between and within the biological entities (populations, species, communities) that make up ecosystems. Further progress are therefore essential to assess by quantity the LCA impacts on biodiversity, considered not only in terms of numbers (richness in species), but also by structural and functional attributes. The actual tools of Life Cycle Thinking offer the opportunity to make comparisons between alternative production scenarios, in order to improve the characteristics of the production process and in consideration of the fact that the facilities for the mass rearing need a standardization yet to optimize its industrial application. Such comparisons may relate to the use of the obtained products: proteins and other bioactive molecules and could be used in terms of performance requirements, to be applied for the realization of the process under optimum conditions.

- Setting up these effective and repeatable systems of mass breeding for certain species of insects as well as reaching production goals for the food and livestock feed branch - reducing organic waste and the negative impact on environmental pollution - could consent a direct access to a vast source of materials and bioactive molecules for other industrial use. Together with the food/feed issue, the use of insects is interesting in different industrial branches, in particular the textile branch (traditional and wild silk production chains), the bio-refinery branch (bio-conversion of organic waste and extraction of fats for the production of bio fuel), the biomedical and cosmetic branch (chitin derivatives, silk biopolymers for the production of biomaterials and cosmetics and extraction of antimicrobial peptides). However this last approach isn't always applicable in growing countries and sometimes excluded regardless. In this case it's better think of food waste as a substrate to grow certain species of insects and to be used (insects + waste) as animal feed. Extra information arises from such practice (animals bread, amount of waste etc...). Only through an in-depth system analysis it is possible to find the most interesting insect species to use for such practice assuming breeding on a small scale.

- The necessity for a greater amount of information about environmental and economical sustainability in food production is needed and the developing of entomophagy can be included in these matters as long as the real problems associated with this practice are evaluated with awareness instead of the superficiality that seems to prevail nowadays. As a matter of facts data shows that 45% of Italians has heard of entomophagy, 52% of them through the television and 18% via the internet, the remaining 55% has never heard of it and roughly 30% is not capable of expressing themselves on the matter.

- Inducing a change in nutritional behaviour in these people is not an easy task. It means setting up a “real and virtual orchestra of different meaning” that plucks the “what” strings in terms of nutritional awareness, trust, customs, correct knowledge, myths and our own memory tightly linked with the “how”. It means being careful not to waste, actively participating and holding together, experimenting, tasting and sharing with the aim of having everyone living in harmony and wellbeing of the planet, thus saving it. Whether we’re talking about insects or not, this step would be easy even in the west if we were to promote the diffusion of this sustainable nutritional culture.

- We see the urge to stress the importance of social sciences as a mean to collect, interpret and understand the complexity of the contemporary social world and the life style of a culture which is technologically mediated. Confirming the absence of a cross-cultural research undertaken to understand the analogies and differences in the perception and acceptance of insects as food. Science and technology are very important but, in an efficient sustainable program, they must be contextualised to obtain a “respectful” change and consensual diffusion.

In conclusion, this experience has helped us to value some important and concrete aspects related to breeding and consuming insects. With this document we intend to promote a “real” sustainable development in a non-emergency, pragmatic and respectful way.

This document represents the chance to share information with public institutions, collect data and as a result facilitate the diffusion and debate of the innovative and critical elements which emerged from this synergetic experience that could address and promote the development of future research projects within Italian universities together with other public entities or private entrepreneurs (in respect of CE guide lines) to integrate information and demands of those who ask for a higher attention to real needs, for a sustainable program to stimulate interest to “actively” participate in political community and support effective projects against poverty and social exclusion, finally giving new opportunities to industries and job market.

The original document collects the technical contributions of the network of researchers from universities, research centers and private companies that have joined the initiative and made the first Italian network of entomophagy. Full documentation is available in www.edibleinsect.it.

The cover picture is taken from the video “edible insects” (<https://vimeo.com/129470280>).

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