Perspective

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Animal-free strategies in food safety & nutrition

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Description

EU-food legislation aims to ensure that food products and their ingredients are safe for consumers as well as for the environment. In 2002, Regulation (EC) No 178/2002 laid down the general principles and requirements of food law (known as the General Food Law Regulation, GFL1). Based on the GFL and subsequent sectoral regulations and directives dealing with specific aspects of food safety, safety assessment or testing requirements of varying specificity are required that will be discussed in this publication. The food industry faces the challenge of assessing foodstuffs and food components for the general population, while using animal safety testing for extrapolation purposes can at times be of limited relevance for humans. Therefore, there is a need to develop models and methods that better predict effects in humans.

Methods and Approaches

Methods and approaches that can be used in toxicology and safety assessment are changing at a faster pace than ever. Members of the International Life Sciences Institute (ILSI) Europe have formed an expert group to review possibilities, opportunities and challenges for the potential use of non-animal testing strategies in food safety research, which can ultimately be used in support of regulatory submissions for pre-market authorisation. In this paper, non-animal methods or approaches refer to the 3 R s concept (Replacement, Reduction and Refinement) (Russel & Burch, 1959), meaning the use of animal-free methods when and where possible, but any opportunity to reduce or refine would also be appropriate.

Azolla is a small, free-floating water fern with a global distribution. Azolla can be used as a feedstock because it is high in proteins, fatty acids, amino acids and vitamins. Low economic productivity in some countries due to increased import costs is still ongoing if the future still depends on the same sources of protein, i.e. soybeans and maize. This paper reviews the studies on the use of azolla in livestock, poultry and fish nutrition as a promising source of a feed ingredient. A systematic literature review according to PRISMA method was performed using Scopus, Science Direct and Pubmed. Only studies conducted using primary data were considered. Protein content in azolla species is in a range of 21–26%, dry matter, while fatty acids ranged from 41% to 66% dry matter. Azolla is rich in various classes of active compounds such as phenolic content, caffeoylquinic acid derivatives, tannins, and carotene. Azolla has been shown to improve the growth rate of animals, depending on the percent of inclusion in animal's diet. The most common species of azolla used as animals' feedstock is Azolla pinnata. The impact of azolla as a feed ingredient in the food production system on the environment has been addressed, including greenhouse gas emissions, carbon footprint, low land requirements, and amino acid-enriched feedstuffs. Future study on labour cost minimization, life cycle analysis, and optimization techniques should be carried out.

Food insecurity, protein-energy malnutrition, and food-feed competition have motivated the search for alternative food and feed sources for human and animal nutrition. According to the FAO, only four crop species provide half of the plant-based calories in the human diet. This review, with an inquisitive focus on investigating alternative potential food and feed sources, has revealed that the Vigna genus (an important group of legumes) possesses more than a 100 species from which only 10 have been domesticated and are being given better attention. Thus, more than 90 species are still under-exploited despite their probable huge potential to alleviate food insecurity either by adding food varieties (domestication) or by providing information for breeding purposes. The review further demonstrates that the utilization of the wild Vigna species for both human food and animal feed is still very limited because of the unawareness of their potentials over some improved varieties which are facing challenges. An increased scientific effort towards exploring the potentials of wild legumes is recommended in planning the future food strategies.

Threshold of Toxicological Concern

However, there is a great deal of uncertainty among both producers and regulators alike about which non-animal methods or approaches are useable for food safety and should hence be accepted for regulatory purposes. For example, in the context of current re-evaluations of food additives, the European Food Safety Authority (EFSA) still recommends through its guidance documentation a lot of animal tests, whereas their expert judgement might enable safety-assessment based on Weight of Evidence using existing animal data and information from non-animal strategies. As previous publications indicate, there are still concerns regarding the applicability of in vitro and in silico

methods to predict food safety or to test complex foodstuffs and regarding the use of the Threshold of Toxicological Concern (TTC) concept for food safety assessment. So far, these methods have been used mainly for risk prioritization and impurity/ contaminant assessment. Initiatives like the launch of Databases and Scientific Data Warehousing, such as OpenFoodTox, EFSA's chemical hazards database providing open source data (chemical and toxicological information) for individual substances. These initiatives should help to increase their acceptance in the near future. To obtain clarity about the acceptability of non-animal methods or approaches, sector legislation should ideally be updated frequently to reflect technical progress in the use of scientific evidence under food legislation. However, legislative updates tend to lag behind the scientific developments and hence there is a practical discordance or dilemma.