A website to showcase the human-friendly aspects of termites

Few insects are as universally and as passionately loathed across the world as termites are. As is the case with mosquitoes and houseflies, the aim of nearly everyone is to find a way to eradicate the termites or to at least reduce their numbers so drastically that they cease to be a bother. But termites are essential for the survival of humankind. Alongside ants and earthworms, termites are the main tillers, movers and rejuvenators of the world's soil[1]. Of this animal trinity, which is often referred to *soil engineers*[2], only termites possess the additional ability of digesting lignin and fixing nitrogen[3]. About 70% of the Earth's land surface is inhabited by one or more termite species[4]. In tropical and subtropical regions, termite biomass density can be as much as three times that of mammalian herbivores[4], contributing a lion's share to the global estimated lignocellulosic debris consumption of 3–7 × 10^{15} g by termites[5]. A major portion of this debris is mineralized, making it bioavailable. This becomes possible because 'lower' termites have cellulolytic flagellates living symbiotically in the termite gut which can digest lignin and the 'higher' termites, which constitute 75% of all known termite species, have their own special enzymes, as also enzymes derived from symbiotic bacteria, which enable them to mineralize lignin. Termites also harbour a bewilderingly diverse microflora, including microbial species found nowhere else in nature[3]. Termites are not only among the very few living organisms in the world with the ability to fix nitrogen, but are also the most numerous[6].

If termites are eradicated, all the presently vegetated surface of the earth would soon be sealed-off by the ligninous debris of fallen wood and twigs, making any further land-based primary production impossible. And if termite populations are continuously threatened as is occurring by the increasing use of termite repellants and termicides, it will harm the world's agricultural productivity and make us more dependent on chemical fertilizers, with concomitantly greater greenhouse gas emissions and environmental pollution.

The fact is that less than 10% of termites have been declared as pests and it is bad environmental management rather than any inherent human-unfriendly aspects that has made pests out of most termite species[1,7].

We have been studying the use of termites in treating biodegradable solid waste, especially ligninous or 'hard' waste which defies anaerobic digestion, composting or vermicomposting[8,9]. A patent claim based on the novel process developed in the course of these studies has been registered[10]. Termites have also been revealed as a source of highly nutritious food for poultry and humans[11]. To highlight these and other beneficial roles which termites play, we have created an interactive website – http://www.termigradation.com – which stores as well makes available or leads to all existing reports on termites. We request contributions for archiving on the website.

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Towards regulating nanomaterials in Indian food industries

The applications of nanotechnology in food industry include improved food processing and packaging, microbiological control, improved texture and flavour. Also nanosensors are used to detect pathogens and contaminants that can affect food quality[1]. Due to the small size they can easily enter the blood stream while their enhanced surface provides them with the potential of greater reactivity[2,3]. In India, recent years have seen increased availability of nanotechnology-related food products, indicating potential exposure of the Indian population to nanomaterials. Therefore, it is necessary to be aware of the presence of nanomaterials in food products and to identify the regulatory challenges in minimizing inadvertent exposure of the Indian population.

In India, current regulations for food safety may not be suitable for nanomaterials because they are applicable to conventional chemicals. On the other hand, the Government agencies or regulatory bodies from different countries are working towards the laying down of standards for a directional usage of nanotechnology. For example, the US Food and Drug Administration[4] makes it mandatory for the producers to label products containing nano ingredients. In Australia, the nano food products are controlled under the Food Standards Australia and New Zealand[1]. An intergovernmental agency Codex Alimentarius Commission, established by FAO and WHO, aims at identifying gaps in our knowledge on food safety issues and review current risk assessment procedures that may arise from nanoparticles[3]. The Food Safety Standard Authority of India[5] has information on some contaminants in food, such as pesticides, chemicals and metal ions, but not on nanomaterials. Recently, the Bureau of Indian Standards has set up a technical committee on nanotechnology that includes utilizing and understanding the nanoscale materials for novel use; the findings of this committee have yet to be considered. These developments indicate the need for more efforts towards ensuring safe usage of nanotechnologies in Indian food industries. For India, it is imperative to lay a substantial standard/regulation that addresses the potential health risks as well as monitor the labelling and safety valuation of nanoscale materials used in food products, an important step towards regulation and usage of nanotechnologies in Indian food industry.

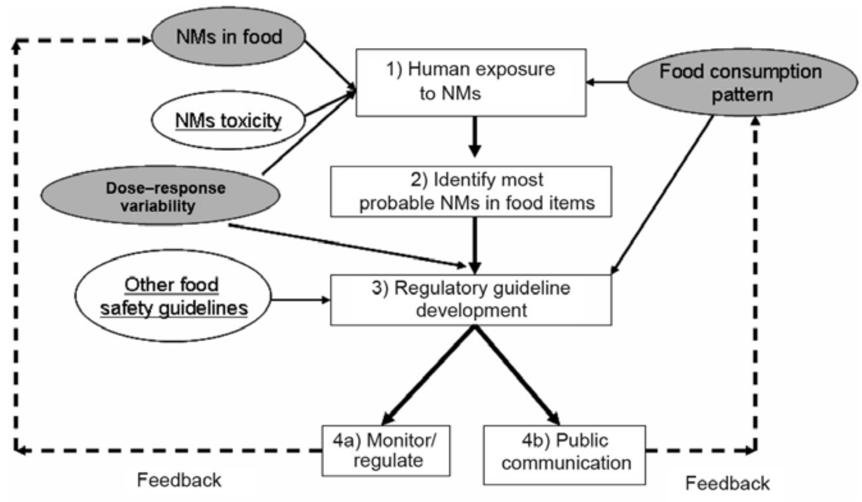

Figure 1. Schematic representation of complexities involved in regulating usage of nanotechnologies in Indian food industries. Data gaps are shown in grey colour circles. Available knowledge is shown as underlined text. Broken lines indicate feedback lines.

Figure 1 is a schematic representation of complexities involved in regulating usage of nanotechnologies in Indian food industries. This involves four major steps for developing guidelines on the usage of nanomaterials in food items, which depend on many factors. Information such as oral toxicity due to nanomaterials and their dose-response data is available from the literature, which has been used by different regulatory agencies across the world and could be used in India as well. However, data gaps exist in information specific to India, such as (1) data on the occurrence of nanomaterials in food items available in the Indian market; their physio-chemical characteristics and stability in food items; (2) the Indian consumption pattern of nanotechnology related food items and (3) dose–response variability of the Indian population for nanomaterials. This information is India-specific and needs to be obtained in order to develop guidelines and regulations, applicable for the country.

More efforts are needed to obtain the above mentioned information in a structured manner. The following three steps could be used in this regard:

1. Develop a database of nanomaterials in food items available in the Indian market (i.e. ‘nanofood database’) which could consist of the following information: physio-chemical characteristics, usage types in food items; stability in different food items; types of processing methods used in different food items and detection methods for nanomaterials.
2. Determine public consumption behaviour of nanotechnology related food items.
3. Identify existing guidelines from other regulatory agencies which could be applicable in the Indian context and also devise new guidelines specific to Indian conditions.

This knowledge could aid in formulating regulations regarding the usage of nanomaterials in food products, so that exposure of Indian public to nanomaterials could be minimized from food items as well as to ensure availability of benefits of nanotechnology in food items for the Indian population.

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