



**INSTITUTION OF AGRICULTURAL TECHNOLOGISTS,
BENGALURU**



**EVALUATION OF RKVY PROJECTS
OF
UNIVERSITY OF AGRICULTURAL SCIENCES,
RAICHUR**

**“APPLICATION OF NANOTECHNOLOGY
IN
ENHANCING QUALITY
OF
AGRI PRODUCE”**

**INSTITUTION OF AGRICULTURAL TECHNOLOGISTS,
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APPLICATION OF NANO TECHNOLOGY IN ENHANCING QUALITY OF AGRI PRODUCE

EXECUTIVE SUMMARY

Agriculture is always most potentiated and stable sector because it produces and provides raw materials for food and feed industries. Due to the increasing world population, increased nutrient mining, for increase the total food grain production, shrinking arable lands, restricted water availability, deteriorating soil organic matter, climate change and so many other reasons, it is necessary to use the advance technologies.

The term "Nano technology" has been defined as the branch of the science that deals with the understanding and control of matter at the dimensions of about 1-100 nm by the US Environmental Protection Agency. It includes controlling, building and restructuring of the devices and other materials of physical, chemical and biological features at nano scale level, i.e., on the scale of atoms and molecules (a nano meter (nm) is one billionth (10^{-9}) of a meter). The functionality can be added to nano particle by interfacing them with biomolecules or structures (Tejpal Dheva, 2015).

Nano technology is an integration of different range of applied sciences such as chemistry, physics, biology, medicine and engineering in which the structure of the matter is controlled at the nano meter scale to produce materials having unique properties such as high surface area, target site of action and slow release.

Although the scientific studies on the applications of nano technology in agriculture are less than a decade old yet the prospects of nano technology in this field are considerable. The rapid developments in the nano sciences have a great impact on agricultural practices and food manufacturing industries. The significant interests of using nano technology in agriculture includes specific applications like nano fertilizers and nano pesticides to trail products and nutrients levels to increase the productivity without decontamination of soil, water and protection against various biotic and abiotic stresses. Nano technology may act as sensors for monitoring soil quality of agricultural field and thus it maintain the health of crops (Prasad et al., 2017). Nano technology will transform agriculture and food industry by innovation of new techniques such as precision farming techniques, enhancing the ability of plants to absorb nutrients, more efficient and targeted use of inputs, disease detection and control diseases. Increase the nutrient use efficiency of applied fertilizer with the help of nano clays and zeolites and restoration of soil fertility by releasing fixed nutrients. It also plays an important role in developing new generation of pesticides with the safe carriers. Nano herbicides are being developed to address the problems in perennial weed management and exhausting seed bank of weed. Levels of

environment pollution can be evaluated quickly and effectively by gas sensors and nano smart dust (Shaimaa and Mostafa, 2015). Nano technology has an enormous potential to offer smarter, stronger, cost-effective packaging materials, biosensors for the rapid detection of the food pathogens, toxins and other contaminants or food adulterants., preservation and packaging of food and food additives, strengthening of natural fibre, removal of various contaminants from the soil and water bodies by using functionalized nanoparticles and improving the shelf-life of the vegetables, flowers and fruits.

In recent years, some devices and tools developed by Nano technology such as nanodevices, nano capsules etc., are being used to detect and treat the plant diseases, delivery of active components to the desired target sites, treatment of waste water and also to enhance the absorption of nutrients in plants. The targeted delivery of nanoparticles not only reduces the damage to non- target plant tissues, but also minimizes the amount of harmful chemicals that pollutes the environment. Hence, this technology is not only eco-friendly but also helps in reducing the environmental pollutants. There are some specific nanoproducts that have been developed for using as soil-enhancer products which promote the even distribution of water and storage. Thus, useful in water saving. Besides, some of the important developments in production of Nano technology products like nanomaterials, nanostructures, nanofibers, nanotubes, etc. with unique physical, mechanical and chemical properties which make them electrochemically active. Such devices play vital role in plants and animal breeding (Prasanna, 2007), genetic engineering and also have been applied in biochemical sensors due to rapid response along with high sensitivity.

Nanomaterials can also be used in delivery of nutrients and pesticides in the plants (Srilatha, 2011), analysis of soil samples and waste water treatment. Agricultural wastes have attracted their uses as raw materials for the production of nanomaterials. Several efforts have been taken to obtain the nanocomposites based on biomaterials. The productions of nanocomposites are more sustainable and have beneficial properties as compared to the conventional materials such as microcomposite and macrocomposite materials.

Keeping the above in view, “**APPLICATION OF NANO TECHNOLOGY IN ENHANCING QUALITY OF AGRI PRODUCE**” was taken up by University of Agricultural Sciences, Raichur with Rashtriya Krishi Vikas Yojana funding. The project was implemented during 2012-13. The details of the project are as under:

1.	Title of Project	:	“APPLICATION OF NANO TECHNOLOGY IN ENHANCING QUALITY OF AGRI PRODUCE”
2.	Nodal officer and Principal Investigator	:	Dr. Sharanaguda Hiregoudar, Asst. Professor, Department of Processing and Food Engineering, College of Agricultural Engineering, University of Agricultural Sciences, Raichur
3.	Implementing Institution (S) and other collaborating Institution (s)	:	Departments of Entomology, Microbiology, College of Agricultural Engineering, Raichur
4.	Date of commencement of Project	:	2012-13
5.	Approved date of completion	:	2012-13
6.	Actual date of completion	:	2012-13
7.	Project cost	:	Rs. 50 lakhs

The objectives of the project are as follows:

1. Improve the food safety and provide the nutrient, diet-based food product by developing the Functional Foods and Nutraceuticals.
2. Nano coating materials to protect from insect pests and diseases for minimizing the post-harvest losses.
3. Study the causes and remedies for improving the chemical properties of water.

The focus of Evaluation is:

- i. To evaluate the importance of biosynthesis over other methods of production of nano particles.
- ii. To evaluate the utility of the Centre for Nano technology for enhancing the quality of agricultural produce.
- iii. To evaluate the impact of nano particles on insects and pest activity during storage.
- iv. To evaluate the importance or role of nanoparticles in waste water treatment and purification of drinking water.

Work conducted on improving the food safety and providing nutrient, diet-based food product by developing Functional Foods and Nutraceuticals was mainly confined to improving the nutritional quality of spinach by application of nano zinc.

Another experiment on effect of nano particles on keeping quality of fig revealed that coating fruits with nano particles would delay the maturity development and improve the shelf life.

While the experiments have given encouraging results on use of nanoparticles for improving the food quality, there is need to evaluate their use in the food produced in the area rather than attempt crops which are not normally grown in the area. The very concepts of functional foods, nutraceuticals and food supplements are new in India and are yet to establish commercially even in urban areas in the country. With a vast majority of the population in the region living in rural and semiurban areas, the focus of the research could have been more apt had it been concentrated on improving the food quality of common foods consumed in the area.

Storage pests are a big menace in most of the pulse crops grown in the area. Work on use of nanoparticles for control storage pests is the need of the hour. The most common pulse pests are the cowpea weevil (*Callosobruchus spp.*) and pea weevil (*Bruchids pisorum*). The cowpea weevil has a life span of 10–12 days while the pea weevil only breeds one generation per year. Pulse beetle (*Pachymerus chinensis*) mainly feeds on cowpea, pea, gram, arhar, soybean, beans etc. The damage is caused by the grubs by eating out the entire content of the grain, leaving only the shell behind. Attack of these beetles often starts in the fields from where it reaches the stores. Khapra beetle and Lesser grain borer feed on arhar, peas and urd. Under these circumstances, use of nano particles for managing stored pests is a welcome idea.

Studies undertaken for designing a Nano adsorbent filter system for dairy plant effluent treatment undertaken by the University has met with success. Nano adsorbents for various types of pollutants like BOD and COD, phosphate, sulphate and nitrate were used for effluent treatment. Nano adsorbents have shown reduction efficiency varying from 64% to 97%.

Water filtration system for removal of fluoride and arsenic (Domestic model – 15 L capacity) has been developed which has arsenic removal efficiency of 87 % and Fluoride removal efficiency of 92 %. The Cost of the model is Rs. 1000.00. The model has been installed at Government school, Mavinamatti, Shahapur, Yadgir (Dist) in collaboration with IIT, Chennai for removal of arsenic from drinking water. This has immense commercial value and the University has already developed more than 100 filters and distributed to public.

REFLECTIONS AND CONCLUSIONS

1. The very concepts of functional foods, nutraceuticals and food supplements are new in India and are yet to establish commercially even in urban areas in the country. With a vast majority of the population in the region living in rural and semiurban areas, the focus of the research could have been more apt had it been concentrated on improving the food quality of common foods consumed in the area.
2. Storage pests are a big menace in most of the pulse crops grown in the area. Work on use of nanoparticles for control storage pests is the need of the hour. There is need to focus on this aspect as the region is the major pulse growing region in the State.
3. Final analysis and toxicity work with selected the insecticides for control of storage pests and study the storage losses including Malathion - Nano malathion, Fenvalerate - Nano Fenvalerate, Emamectin benzoate - Nano Emamectin benzoate, Thiodicarb - Nano Thiodicarb, Sweet flag - Nano Sweet flag and Neem seed kernel powder - Nano Neem seed kernel powder is under progress. This should be completed quickly and its commercial application should be taken up.
4. Studies undertaken for designing a Nano adsorbent filter system for dairy plant effluent treatment undertaken by the University has met with success. This should pave way for use of the technology in treatment and reuse of waste water in urban areas.
5. Water filtration system for removal of fluoride and arsenic (Domestic model – 15 L capacity) has been developed which has arsenic removal efficiency of 87 % and Fluoride removal efficiency of 92 %. The Cost of the model is Rs. 1000.00. Commercial production of the filters should be taken up in PPP model.

ACTION POINTS

1. The equipment procured under the project are exemplary. However, their maintenance cost will be too high. Hence, it is better to convert the centre on PPP mode and generate data as well as work efficiently and maintenance on self sufficiency mode.
2. The techniques of nano encapsulation of ingredients, additives and supplements are good but should be tested for food safety and FSSAI before releasing for commercialization.
3. The techniques of nano particles mixing for effective control of insect pests is a good move. However, its economics needs to be worked out.
4. There is need for working out cost economics of use of nano silver particles and magnetic power used for purification of water and its safety as per FSSAI standards.
5. Side effects on nano particles on human beings needs to be worked out.

6. Studies undertaken for designing a Nano adsorbent filter system for dairy plant effluent treatment undertaken by the University has met with success. This should pave way for use of the technology in treatment and reuse of waste water in urban areas.
7. Water filtration system developed for removal of fluoride and arsenic should be taken up for commercial production of the filters in PPP model.
8. Storage pests are a big menace in most of the pulse crops grown in the area. Work on use of nanoparticles for control storage pests is the need of the hour. There is need to focus on this aspect as the region is the major pulse growing region in the State.
9. With a vast majority of the population in the region living in rural and semiurban areas, the focus of the research could have been more apt had it been concentrated on improving the food quality of common foods consumed in the area.

RESEARCHABLE ISSUES

1. Initiate work on nano silicon and its impact on diseases and nutritional issues.
2. Research on nano microbial components needs to be initiated.
3. Strengthening of research on nano remedial measures for insects and diseases management.