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BRIDGING THE GAP: ASSESSING FOOD INDUSTRY-ACADEMIA COLLABORATION IN IMPROVING FOOD, NUTRITION, AND HEALTH

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Abstract
Food, Nutrition, and Health are important due to their immense influence on the well-being of an individual as well as in public health. This survey-based paper aims to bridge the disconnect between theoretical models and actual industry application through a structured questionnaire. The survey utilized a structured questionnaire to encourage a collaborative approach in order to improve public health and thereby control chronic health issues. This paper advocates for an association between industry and higher educational institutions to improve collaborative research in the food sector which in turn will help to produce sustainable food through modern technology. It attempts to apprise the reader of the problems responsible for the lack of effective association between industry and academia at large. It explains the role of the food industry specifically to augment the practical skills of learners through internships and research. Such collaborations can lead to innovations in food technology, sustainable agricultural practices, development of novel functional foods, phytonutrients, and supplements. The majority of those surveyed agreed that the Food Industry-Academia association would accentuate employability in the sector apart from providing the food industry with a skilled workforce. The Industry-Academia connect would benefit students in terms of enhanced networking skills and a curriculum with modern food technology. The respondents selected multiple options for the roles that policymakers should play in facilitating effective industry-academia collaborations; i.e., provide funding, create supportive regulations, encourage partnerships, and set up collaborative platforms. Thus this paper will promote Food Industry-Academia linkage to improve public health and mental wellbeing.
Keywords: E food, Skills, Collaboration, Industry, Academia.

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1. Introduction

1.1 Nutrition and Health:

A balanced and nutritional diet is the key to good health. Nutrition deals with the study of nutrients in food, how the body uses them, and the association between diet, health, and disease.

Our bodies come across persistent danger from chemicals called free radicals. Free radicals are generated in the body as inevitable by-products during metabolism, physical exercises or exposure to cigarette smoke, air pollution, and sunlight. In higher concentrations, free radicals are capable of damaging cells and the genetic material in them.

Some nutrients act as antioxidants. Vitamins C, Vitamin E, beta-carotene, other related carotenoids, and phytoestrogens are antioxidants that may neutralise the effects of free radicals. Others include glutathione, coenzyme Q10, lipoic acid, flavonoids, phenols, polyphenols, and many more [1] - [3]. If too many toxic compounds remain in the body, cell damage and disease

can result. In modern times, the use of processed foods and ready to eat foods have become popular due to the paucity of time that people use for cooking. Many food products require storage and transportation and the suppliers have to see to it that they are delivered to consumers with safety and quality assured. There is a constant search for newer approaches to enhance the quality and shelf life of food. This is achieved by reducing oxidative damage by incorporation of antioxidants to delay the oxidation of biomolecules. Natural antioxidants extracted from vegetables and fruits possess great potential to be used as preservatives, replacing the synthetic ones [4], [5]. The food processing sector in India showed a 11.8% Compound Annual Growth Rate during 2015-16 to 2018-19. This is due to use of modern equipment, making the industry more efficient and leading to a demand for skilled workforce [6]. The food processing sector currently employs approximately 70.44 lakhs of the workforce in food processing units (Ministry of Food Processing Industries, 2022). Among these, the majority of workers have not had any suitable, approved, or informal skill training [7]. To improve the skilled workforce and take advantage of our vast population, it is very important to educate and develop technical skills in both the existing workforce as well as future generations.

Food, nutrition, and health play an important role in modern times due to their immense influence on the wellbeing of an individual as well as public health at large. It is important that the researchers in the food and nutrition domain collaborate with policy makers to ensure that food recommendations are drafted taking into consideration scientific evidence. Effective food industry-academia partnerships can help bridge the gap between science and policy, leading to well-informed food and nutrition policies. [8]

An example of this type of collaboration is Nestlé Health Science & The Enterome Partnership. This was a research collaboration and licensing agreement for a potential drug candidate. This collaboration has successfully developed Microbiome-based drugs in particular. [9]

Collaboration between a higher educational institute and an industry helps to accelerate research by bridging the gap between an institutional laboratory finding and a marketable product. [10]

1.2 Gaps in Knowledge on Food, Nutrition, and Health:

The gut microbiome, defined as the complex community of microorganisms living in the human digestive tract, is considered to be a very important factor in overall health. The specific mechanisms by which the gut microbiome influences various aspects of health, such as the immune system, metabolism, and brain health is still being studied. Further research is needed to study these complex interactions and help us alter our foods to modify the gut microbiome for enhanced health outcomes. [9]

1.3 Technology:

The progress in Agricultural and Food technology has improved food production, processing, storage and distribution. Modern techniques used encompass genetically modified organisms (GMOs), food fortification, and alternative protein sources. These innovations simultaneously offer opportunities and pose challenges for nutrition and health. The incorporation of new technologies must consider safety, ethical implications, and the socio-economic impacts on farmers and consumers. Balancing innovation with sustainability and public health is crucial for the future of food systems. [11]

1.4 Holistic Curriculum:

National Education Policy (NEP) 2020 inspires the development of a curriculum that is more holistic and aims at integrating practical knowledge with theoretical learning. In the context of food, nutrition, and health, this would involve linking modern scientific research, nutritional

guidelines, and practical skills required for food production, nutrition assessment, and health promotion. [12]

1.5 Skill Development:

The NEP 2020 emphasizes on skill development and vocational courses in higher education. With respect to food, nutrition, and health this would include skills associated with agriculture, sustainable food manufacture, food processing, innovative cooking techniques to preserve nutritional value of foods, as well as nutrition counselling. The Industry-Academia connect would benefit students in terms of internship opportunities, enhanced networking skills and a curriculum with modern food technology. The food industry would benefit in terms of skilled workforce, innovations from young minds, access to expertise and research and opportunities for knowledge and resource exchange.

1.6 Research and Innovation:

The NEP 2020 encourages research and innovation in all disciplines. Concerning food and nutrition, this would comprise collaborative research projects between higher education institutes and food industry partners. These collaborations can lead to innovations in food technology, sustainable agriculture practices, development of novel functional foods, phytonutrients and supplements. [13]

1.7 Community Welfare:

The NEP 2020 motivates higher education institutes to promote public health through community engagement programs. In the context of food, nutrition and health, academic institutions can collaborate with government health agencies and non-government organizations to develop educational programs in hygiene, nutritional counselling, conduct food safety testing and campaign for healthy eating habits. [14]

1.8 Policy Support and Implementation:

Academic institutions in association with government health agencies, should play an active role in framing public policies related to food, nutrition, and health. Enhancing the industry-academia connect will enable researchers to contribute recommendations to policymakers as well as suggestions related to food safety, nutrition labelling, school meal plans, and other wellbeing guidelines. [15]

Policymakers should consider establishing 'Innovation Clusters' demonstrated by the European Institute of Innovation and Technology (EIT) Food initiative, which offers specific grants for joint industry-academia projects focused on viable protein sources. [16]

1.9 Encouraging Entrepreneurship:

The National Education Policy aims to promote entrepreneurship and start-ups across faculties, this can be extended to food and nutrition as well. The Industry-Academia connect can facilitate mentoring, funding opportunities, and incubation support for students and researchers interested in initiating projects related to healthy food products, nutrition consulting services, and sustainable agricultural practices. [17]

2. Objectives

The main objectives of this paper are:

1) To facilitate learners, faculty, industry professionals as well as the general public to appreciate the advantages of collaborations between Food Industry-Higher Educational Institutes.

2) To assess the extent of awareness among people from various sections of society about food, health and nutrition.

3) To motivate learners to acquire the essential skills and proficiencies required in the fields of food, nutrition, and health.
4) To evaluate the main problems involved in effective collaboration between industry and academia.
5) To enable policy changes that encourage the incorporation of nutrition education and research into food industry practices.

3. Methodology

This is a descriptive research study to explore the collaboration between the food industry and higher educational institutes. It attempts to explain how connections between these sectors can influence and improve various aspects related to food quality, nutritional research, health outcomes, and possibly even food policy development. A closed ended survey has been used to bring home the significance of a collaborative approach to enhance public health and control chronic health issues. [18] The **structured questionnaire** comprised twenty-two questions categorised into the following sections:

1. General Information of the respondents.
2. Collaboration and Interaction
3. Impact and Effectiveness of Industry-Academia partnership
4. Needs and opportunities
5. Future Scope of the linkage between the two sectors

3.1 Participants:

The online survey questionnaire was sent to teachers, students, homemakers, industry professionals, and retired professionals. It was a non-probability convenience sampling to ensure representation across age groups, various professions as well as students who are at the receiving end of the outcome of this research.

3.2 Data Collection Method:

The online survey method was used, so as to reach out to various professionals, teachers from different colleges and universities, industry professionals, microbiologists, as well as students. Data was collected by sending the online survey questionnaire via email and social media platforms, allowing for a broader reach and higher response rates as compared to traditional paper-based questionnaires.

3.3. Moral Considerations:

Participants were informed about the intention of the questionnaire through a descriptive paragraph before the questions. There were no questions asked to reveal the identity of the participant, so as to maintain confidentiality.

4. Results and Discussion

The online survey on Industry-Academia linkage on improving Food, Nutrition, and Health in contemporary times speaks about respondents' opinions and stimulates creative considerations.

4.1. General Information of the Respondents

One hundred and eleven participants responded out of which 38% were in the age group 18-25, 28 % were in the age group of 41- 60, 20% belonged to 26 - 40 age group and 14% belonged to 61-80 age group. Nearly 28% were teachers and academic researchers, 32 % were students, 17% were industry professionals and the remaining included retired professionals and others. Thus, the respondents belonged to a wide range of age groups as well as varied professions, making the survey unbiased. 44% of those surveyed were associated with academics, 16% with healthcare,

5% with food industry, 4% Nutritional Science, 3% Government policy makers, 30% of those surveyed did not belong to any of the fields listed. Due to the sampling method, the findings are exploratory and may not be representative of the entire population and the results cannot be generalised.

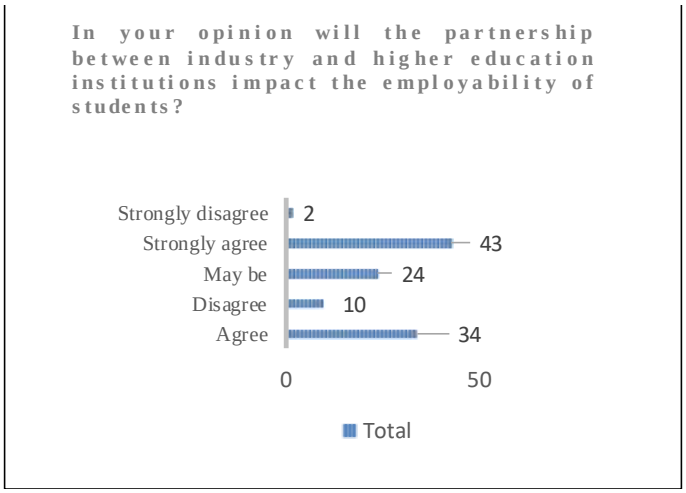

Fig.1 Impact of IAC on Employability of Students

4.2. Collaboration and Interaction

30% of the respondents had never been engaged in collaborations between industry and academia, another 30% rarely made such partnerships, 25% were occasionally involved in collaborations and only 14% regularly engaged in such collaborations. Among those who collaborated, 47% did so for workshops and conferences, 32% collaborated for student internships and placements and 20% for academic consultancy and 19% collaborated for research.

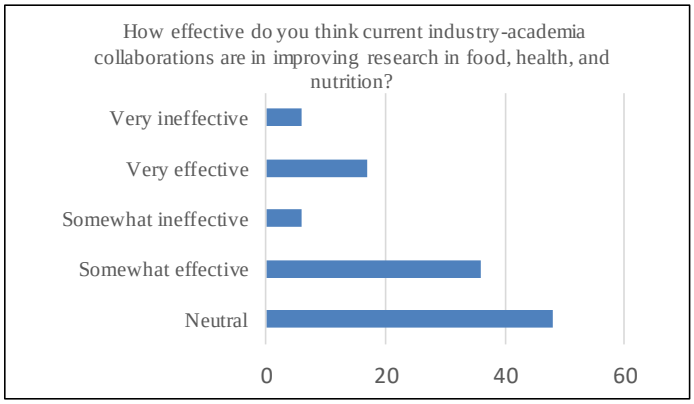

Fig.2 Efficacy of IAC in research in food, health, and nutrition

4.3. Effectiveness of Food Industry-Academia Partnership

- 55% of the respondents were of the opinion that the main problem to effective collaboration between Industry and Academia was different goals or expectations of the two entities.
- 43% of those surveyed were neutral about the fact that industry-academia collaboration can improve food, nutrition, and health. 31% felt it could be somewhat effective and only 14% of respondents were of the opinion that it can be very effective.

- 78.37% of the respondents agreed that industry–academia collaboration will impact the employability of students, remaining 21.63% were not sure if this collaboration would impact students' employability.
- A Chi-Square test was performed to determine the association between opinions of Industry professionals and students.

Null hypothesis: There is no significant difference of opinion amongst the surveyed industry professionals and students on the partnership between industry and higher education institutions having an impact on the employability of students.

Alternate hypothesis: There is a significant difference of opinion amongst the surveyed industry professionals and students on the partnership between industry and higher education institutions having an impact on the employability of students.

The chi square test gave a p value of 0.179 which is greater than 0.05. Hence the Null hypothesis was accepted and it can be concluded that there is no significant difference of opinion between industry professionals and students on partnership between industry and higher education institutions having an impact on the employability of students.

The Question 'Do you think there will be a negative impact due to food industry-academia collaboration?' received the following responses

Table.1 Negative impact of Food industry-academia collaboration

Responses	**Count of Respondents**
Maybe	37
Never	69
Yes	7
Grand Total	**113**

- 62% of the respondents felt that industry–academia collaboration will never have a negative impact. However, 3% were neutral or felt that collaboration between academia and industry could have a negative impact. This could be due to intellectual property disputes, fear of losing academic freedom, conflicts of interest, restricted sharing of data etc.

4.4. Needs and Opportunities

- 80% of those surveyed agreed that industry–academia collaboration will benefit students of Biological Sciences.

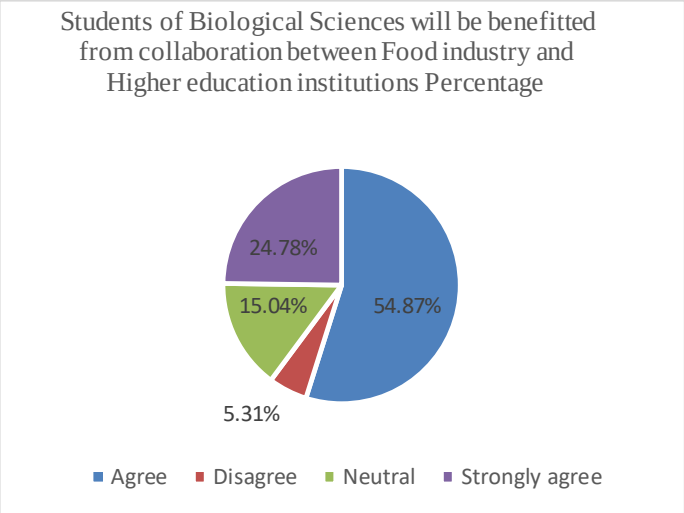

Fig.3 Advantage of Food Industry collaboration with HEI

➢ 97.29% of the respondents of the survey chose the following as specific needs from the current Industry-Academia collaborations in the food industry:

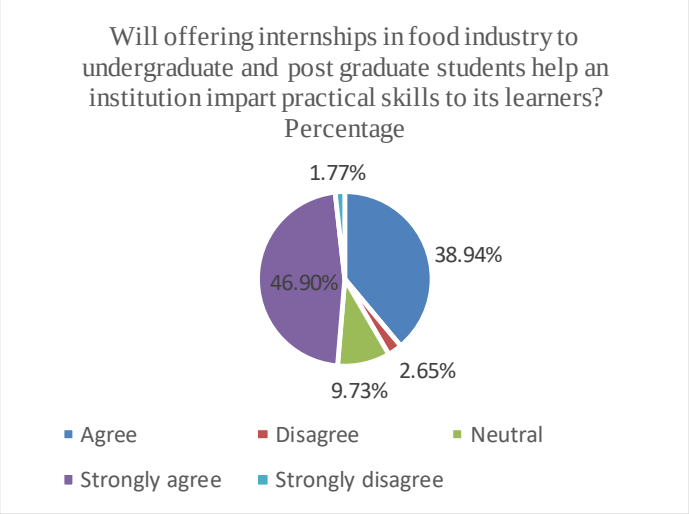

Fig.4 IAC Impact on practical skills to learners

- Curriculum with modern food technology
- Practical skills in food technology
- Enhanced networking skills
- Internships and experiential learning

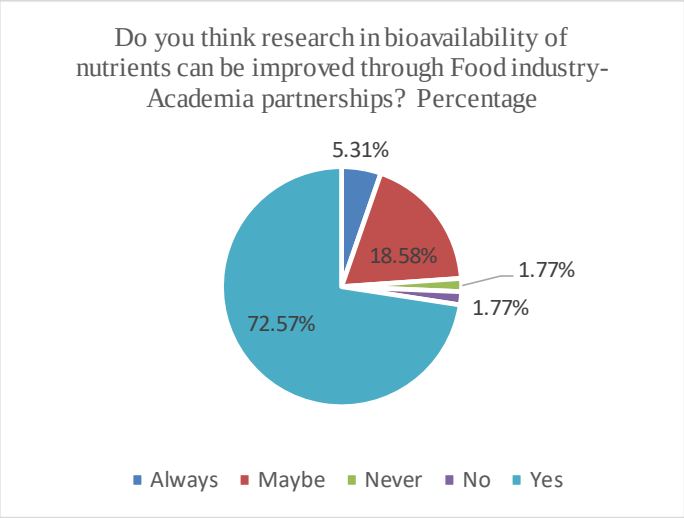

Fig.5 Effect of Food industry-Academia collaboration

➢ 98% of those surveyed were positive about the fact that bioavailability of nutrients can be improved through Food Industry-Academia partnerships.

➢ The respondents agreed to the following corrective measures to improve the value of collaborations between industry and academia:

- ❖ Increased funding opportunities
- ❖ Better communication channels
- ❖ Clearer goals and expectations
- ❖ More networking opportunities
- ❖ Joint workshops and seminars

Table 2. Comparative tabulation of expected positive outcomes from Industry academia collaboration across different strata of society

Profession	**Positive outcomes expected from industry-academia partnerships in Food and Supplement production**			
	Improved research outcomes	Enhanced educational opportunities	Increased innovation	Better industry practices
Student	45.71%	51.42%	45.71%	22.85%
Industry Professional	57.89%	47.36%	68.42%	52.63%
Teacher	56.25%	50%	56.25%	56.25%
Academic researcher	80%	40%	40%	20%
Housemaker	100%	66.66%	50%	66.66%

➢ All of those surveyed felt that the Nutraceutical Industry–Academia linkage will help students of biological Sciences by giving them better research opportunities, internships, help them in skill development and offer them experiential learning.

- 85% of those surveyed believed that offering internships in the food industry to undergraduate and post graduate students will help an institution impart practical skill to its learners.
- 80% of the respondents replied in the affirmative to the question on whether there should be a professional from the industry in the Board of Studies of all faculties.
- The question - In what way will the food industry benefit from collaboration with higher education institutes?
- The question on what role should policymakers play in facilitating effective industry-academia collaborations?

All the options provided in the questionnaire were effectively selected by the respondents. These included research funding, creating supportive regulations, encouraging partnerships and setting up collaborative platforms.

4.5. Future Scope

The results of the survey revealed that people are aware about the latest trends in food and nutrition, upcycled products, fortified products, plant-based products, shift towards super grains consumption, high protein foods, flavour trends, probiotic and fermented drinks, healthy snacking and meal replacers. Upcycled foods are made with ingredients that would not have otherwise been consumed by humans, according to the Upcycled Food Association. Many food companies upcycle food waste into new products from snacks, to ready-to-eat meals, cooking ingredients, and more.

- Most of the respondents agreed to multiple options provided in the questions as to how educational institutions can prepare students for careers by bridging the gap between industry and academia
  - Curriculum development
  - Industry internships
  - Research opportunities
  - Professional networking
- The respondents selected multiple options for the roles that policymakers should play in facilitating effective industry-academia collaborations i.e. provide funding, create supportive regulations, encourage partnerships, and also set up collaborative platforms.
- In response to the question, 'In what way will the food industry benefit from collaboration with higher education institutes? Majority of the respondents selected one or all of the following options
  - access to expertise and research
  - development of skilled workforce
  - opportunities for knowledge and resource exchange
  - enhance firms' innovativeness

In the end of the questionnaire, the only open ended question about additional comments or suggestions regarding Food Industry-Academia collaborations in enhancing food, health, and nutrition, many of the survey participants wrote positive statements, encouraging industry-academia collaborations and considering it as a necessity for the future sustainable food industry.

5. Conclusion

Food, nutrition and health in current times are complex issues influenced by various factors including diet, culture, technology, policy, research and innovation. Addressing these challenges requires a holistic approach involving individuals, communities, governments, and international

organizations working together to promote healthier eating habits and improve public health worldwide.

The questionnaire facilitated learners, faculty, industry professionals as well as the general public to appreciate the advantages of collaborations between Food Industry-Higher Educational Institutes.

Aligning to the objectives of the paper, awareness among people from various sections of society about food, health and nutrition was also assessed through the survey. The respondents were cognizant about nutritious foods like fortified products, plant-based products, super grains, high protein foods, upcycled products, probiotic and fermented drinks.

While knowledge is essential, learner motivation is the engine that drives the attainment of skills required in the fields of food, nutrition, and health, which the survey has attempted.

Questions to evaluate the main problems involved in effective collaboration between industry and academia, have revealed that lack of communication as well as different goals and expectations are the main issues. Future MOUs between industry and academia must align these incentives to solve the problem at the very outset.

Policy makers should modulate policies so as to encourage the incorporation of nutrition education and research into food industry practices. They should include corrective measures like providing funding, create supportive regulations, encourage partnerships and set up collaborative platforms. Overall, the food industry-academia connect will provide a background for encouraging collaborative research in food technology and processing, sustainable agriculture as well as nutritional science. It will enhance innovation in the food industry and hence address societal challenges related to food, nutrition, and health. By taking advantage of this connection, higher educational institutions can play a vital role in producing skilled professionals, conducting quality research with grants and expertise from the industry. The linkage will also contribute to the development of tested and framed policies to promote public health and mental well-being in the near future. To add to this, it will provide better internship and job opportunities to the future generations. The food industry with its ever increasing growth rate, an effective industry-academia connection will enable it to get a skilled workforce, to meet its demands.

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