Seminar On Recent Developments In Food Science And Technology For Better Nutrition

REPORT

ILSI India

International Life Sciences Institute-India

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SECTION: 1

Introduction

ILSI-India organized a Seminar on "Recent Developments In Food Science And Technology For Better Nutrition" on April 27 in New Delhi. It was attended by more than hundred participants from Government, Industry and Academia. The objective of organizing this Seminar was to look at recent trends in consumption of important nutrients and impact on health, to discuss how more value can be obtained by using less resources e.g. in terms of carbon foot prints, to review the latest work on use of Artificial Intelligence (AI) in improving food safety and in optimizing nutrition.

The Seminar was chaired by Mr. D H Pai Panandiker Chairman, ILSI-India and co-chaired by Dr. B Sesikeran, Former Director, National Institute of Nutrition and Trustee ILSI-India.

Addressing the Seminar Mr. Panandiker pointed out that science and technology are advancing rapidly and it is necessary to check occasionally whether as food scientist we are really keeping pace with other sciences as well. We have also to look at old issues in the light of new data and have better understanding about the different nutrients in healthy and unhealthy food.

What is more we cannot look at nutrition science in isolation. We have to see how developments in other sciences can be of relevance to understanding nutrition better. The challenges for nutrition and food sciences and technology can only be met by integrating disciplines.

A brief Report on proceedings is given in the following sections.

SECTION: 2

Time Trends in Sugar, Salt and Fat Consumption and Chronic Disease Epidemic in India: Is There a Need for Intervention?

Dr. A. Laxmaiah, Scientist 'G'
National Institute of Nutrition, Indian Council of Medical Research (ICMR)

Sugar, Salt and Fat are the three crucial components of food that affect the overall taste and health. Sugars are crucial compounds from the context of the human organism, where, humans retain the ability to synthesize energy in the body needs from simple sugars present naturally in foods. Sodium is widely used in foods to enhance flavor, improve processing and preserve food, mostly in its salt (Sodium Chloride) form. It is well evident from the scientific research that excessive intake of high sugar, salt and fat through diet show adverse effect on human health. Changes in the world food economy are reflected in shifting dietary patterns, for example, increased consumption of energy-dense diets high in fat, sugar and salt; and refined carbohydrates. These patterns are combined with a decline in energy expenditure that is associated with a sedentary lifestyle and the phasing out of physically demanding manual tasks in the workplace as well as at home.

Because of changes in dietary habits and lifestyle patterns, chronic non communicable diseases (NCDs) such as obesity, type 2 diabetes, cardiovascular diseases (CVDs) like hypertension and stroke, and some gastrointestinal and reproductive cancers are becoming increasingly significant. These morbidities lead to high disability and premature deaths in both developing and newly developed countries, placing additional burden on the national economy. Several studies carried out in developing countries, including India, have reported an increase in the prevalence of diet related NCDs like overweight and obesity, insulin resistance, diabetes mellitus, hypertension, other CVDs, cancers etc., predominantly among urban population. These are major causes of death and disability in India. As per WHO NCD Frame work/India NCD Framework, tracking consumption levels of sugar, salt and fat among population is very important to enable developing policy interventions for bringing consumption levels at suggested levels of ICMR. Therefore, present study was carried out by analysing NNMB dietary data for sugar, salt and fat consumption patterns and trends was brought out with the support of WHO, and ILSI-India useful for policy briefs.

National Nutrition Monitoring Bureau Study Design and Methodology

NNMB surveys estimated consumption levels of sugars, salts and fats in the states of Andhra Pradesh; Karnataka; Kerala; Tamil Nadu; Maharashtra; Madhya Pradesh; Orissa; Uttar Pradesh; Gujarat and West Bengal. NNMB studies are cross sectional longitudinal community based studies. In each state about 120 villages, in each village 20 households were randomly covered in the NNMB rural surveys and salt, sugar and fat was assessed in 5HHs from each village covered for the study. While in case of NNMB urban surveys, 75 wards were covered from 5 randomly selected cities (≥ 1 lakh population) from each state and covered 16 states/UTs in India. About 900HHs, 24 hour recall diet surveys were covered from each state. Visible dietary fats, added salt and sugars were collected through 24 hour recall diet surveys.

SUGAR

Sugars are crucial compounds from the context of the human beings. Humans retain the ability to synthesize energy the body needs from simple sugars present naturally in foods. Most of the dietary sugars are converted to a major fuel, glucose, used by all cells in the body. It is the primary fuel needed by brain tissue for its normal function. Levels of glucose in the blood may vary and when low will impair the brain and cause permanent mental deterioration. Rapidly changing diets and lifestyles are contributing towards the global obesity epidemic. According to recent report of WHO, more than 1.9 billion adults, 18 years and older, were overweight and obese. Once considered the problem related to affluence, obesity is now fast growing in many developing countries and in poor neighbourhoods of the developed countries. Therefore, consumption levels of sugar and sugar sweetened beverages have to be assessed, which enable planner and implementers to develop strategies to maintain its consumption levels at desirable levels. However, as per the NNMB surveys, the mean consumption of sugar among rural and urban population in India is 13g/CU/day and 16g/CU/day, which is lower than the recommended levels of Indian Council of Medical Research (ICMR) - 30g/CU/day. Since, consumption levels of sugar is lower than the recommended levels of ICMR, no significant associations have been observed between sugar consumption and Non Communicable Diseases (NCDs).

Figure 1: Mean consumption of sugar in rural areas of NNMB states

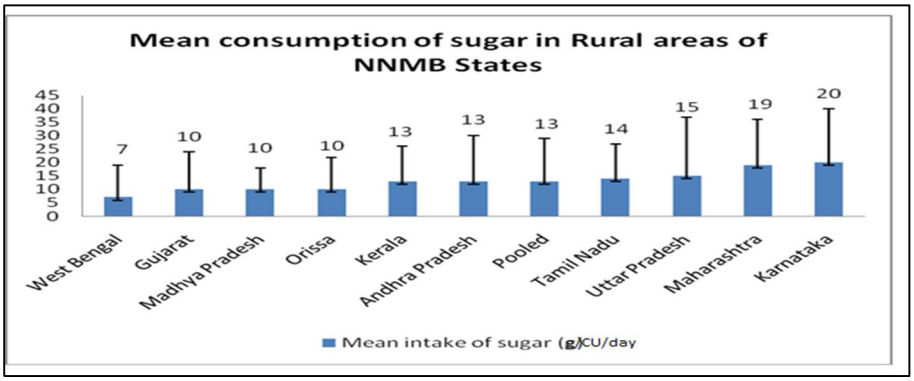
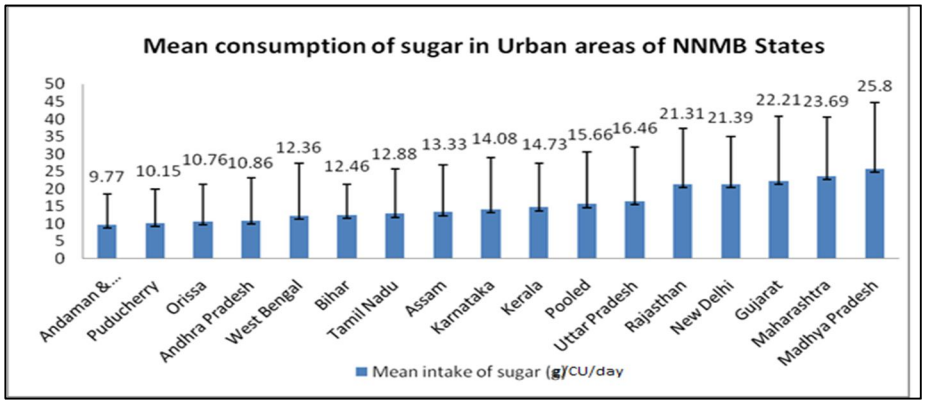


Figure 2: Mean consumption of sugar in urban areas of NNMB states



SALT

Salt is one of the essential nutrients, and is tightly regulated by the human body. Salt use, in general, is a regular practice in daily cuisines. Under normal health conditions, majority of salt (sodium) excretion (93%) occurs through urine and some is also lost through sweat and faeces.

The osmotic properties of sodium regulate extracellular fluid (ECF) volume, and interstitial fluid volume and plasma level. Therefore, total body sodium can determine blood volume and thus blood pressure. There is enough evidence that high levels of sodium intake are associated with an increased risk of blood pressure, which is in turn a major risk factor for coronary heart disease and stroke. The joint report of WHO/FAO on 'Diet, Nutrition, and Prevention of Chronic Diseases (WHO, 2003)' recommended to limit salt intake <5 g/day. The phenotype of salt sensitivity potentially link high salt intake to the elevated blood pressure.

The mean consumption levels of salt in India vary from 7-10g/day. One of the targets is 30% reduction in mean population intake of salt/sodium. The scientific evidences suggest that the consumption of salt, sugar and fat should be regulated to control and prevention of NCDs in India.

If an elevation is observed in the BP levels during a period of high dietary sodium or reduces during a period of low dietary sodium, the individual is called to be Salt Sensitive (T.Kawasaki CS et al 1978). Many population-based intervention studies have demonstrated that when salt intake is reduced, there is a reduction in population BP levels. Research suggests that lower sodium intake would result in the decreased risk of cardiovascular disease and incidence of stroke. Assessment and monitoring of dietary sodium concentrations plays a crucial role in planning and evaluation of sodium risk management strategies. Individuals are often unaware of the detrimental effect of salt on health and in developed countries; the majority of salt consumed is hidden in processed foods.

The International study of Salt and Blood Pressure (INTERSALT), showed a modest association between higher levels of sodium intake and higher blood pressure. The Government of India is one of the first countries to set national targets and develop an action plan for prevention and control of NCDs with 10 targets to achieve the objectives. Close regulation of salt consumption among population is one of the important means for achieving the objectives. The NNMB has been collecting salt consumption data through 24 hours dietary recall method, even though this method has got some inherent estimation errors, but it a feasible estimation method. Studies have shown that the estimation of sodium consumption from 24hour urinary sample is a gold standard method, but it is not feasible in the community setup.

Figure 3: Mean salt consumption (g/CU/day) by state among rural population by state: NNMB surveys 2011-2012

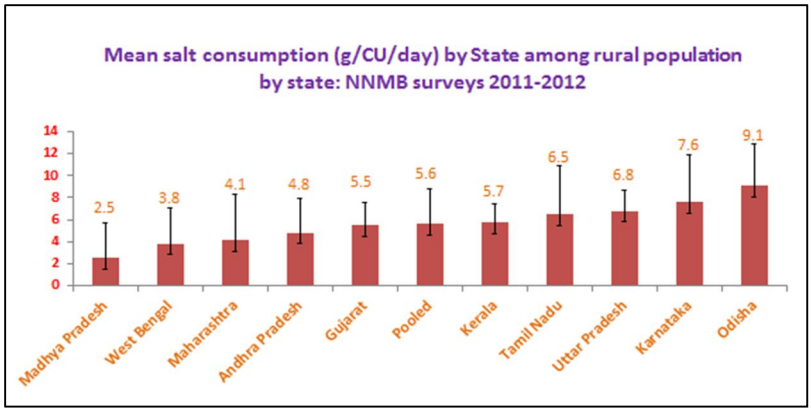


Figure 4: Mean intake of salt (g/day) among urban population during 2015-16

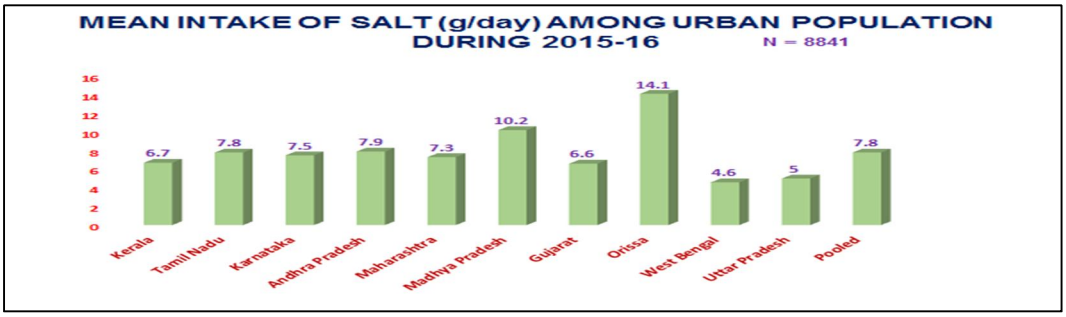


Figure 5: Mean salt (g/CU/day) consumption in different cities in India

State & City	N	Salt (NaCl) (g)	Mean Sodium (Na) as added salt (mg)	Mean invisible Sodium (Na) in foods (mg)	Total Sodium (mg)
Telangana-Hyderabad	**160**	**8.4**	**3276**	**0.51**	**3276.51**
Andhra Pradesh-Vijayawada	**67**	**7.2**	**2808**	**0.49**	**2808.49**
Assam – Guwahati	**40**	**12.8**	**4992**	**0.77**	**4992.77**
Total	**267**	**8.8**	**3416**	**0.54**	**3416.54**

The mean salt consumption estimated by 24 hour dietary recall method in the states of Telangana, Andhra Pradesh and Assam was 7.2g, 8.4g, and 12.8g, which was higher than the suggested levels of WHO (<5g/day). A median intake of sodium was 2.7g/day and 3.3g/day, respectively from spot urinary samples and 24h urinary samples and its Rank correlation was 0.476. It was observed that no agreement between sodium consumption levels estimated from 24h urinary samples and spot urine samples. However, there was a good agreement between the method spot urinary sodium excretion and 24 hour recall method of diet surveys ($p>0.99$) and a moderate agreement was also observed between 24h USE and 24h dietary recall method ($p>0.05$).

The high intake of salt is significantly associated with increase of prevalence of hypertension.

FAT

Dietary fat (lipids) provides energy and essential fatty acids and serves as a vehicle for fat-soluble vitamins and facilitates their absorption. Since fat provides high energy value (9Kcal/g) as compared to carbohydrates or proteins (4Kcal /g), therefore, the fat content of a diet contributes significantly to its caloric density. Fat enhances texture, taste and flavor of food, reduces its gastric emptying and thereby affects satiety. In the body, fatty acids used for generation of cellular energy and biosynthesis of membrane lipids and lipid mediators, are essential in development of central nervous system, modulate lipoprotein metabolism and risk for diet-related non-communicable diseases (DR-NCDs).

The composition of dietary fat is the primary determinant of the main blood lipid risk factors for cardiovascular disease. It is evident that saturated fatty acids increase serum cholesterol and dietary polyunsaturated fatty acids lower serum cholesterol contrarily. Community studies on consumption of diets high in fat, especially saturated fat have shown increased risk of obesity, diabetes, heart disease and some cancers. It all depends on the quality of what fat we are consuming.

The NNMB rural surveys 2011-12 have shown that the mean intake of visible fat among rural population was 15g/CU/day and the intake ranged from a high of 22g/CU/day in the state of Gujarat to a low of 9g/CU/day in West Bengal as against actual requirement of 20g/CU/day (ICMR). While in case of urban population, the mean intake of visible fat was high 28g/CU/day and the intake ranged from a high of 48g/CU/day in Rajasthan to a low of 18g/CU/day in Kerala. The study also showed that the high consumption of fats was positively associated with increase in the prevalence of obesity, body fat per cent and hypertension.

Figure 6: Time trends in mean consumption of visible fat (g/day) among rural population during different periods

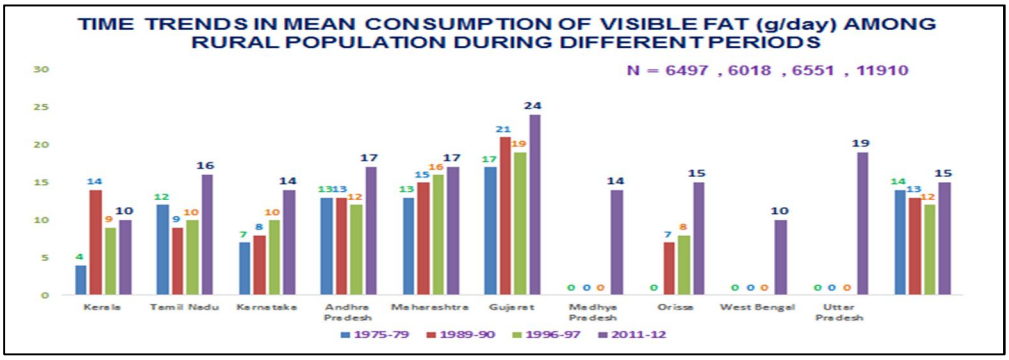
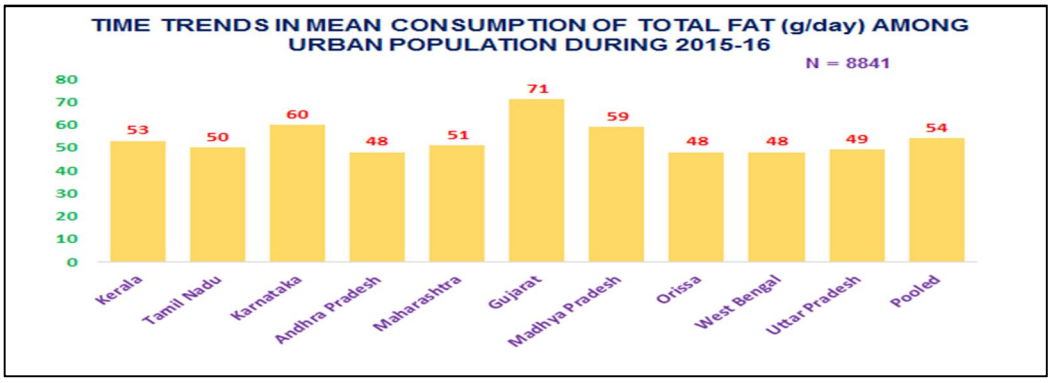


Figure 7: Time trends in mean consumption of total fat (g/day) among urban population during 2015

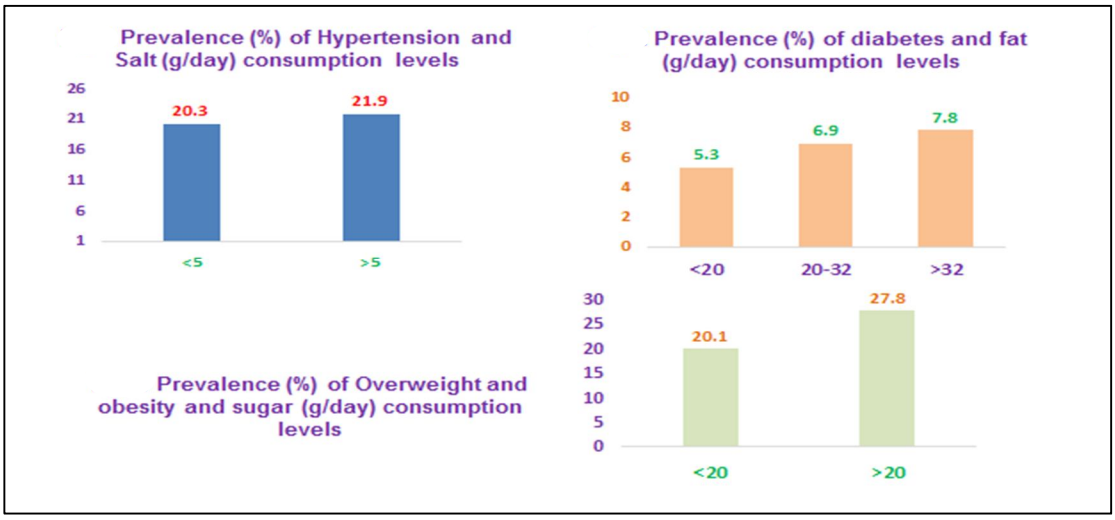


Fat consumption levels significantly increased over a period of time among all the population groups like rural and tribal. Especially, the proportion of people, who are consuming >10g/day salt significantly decreased their proportion over a period of time. Mean consumption levels (as well as >20g/day) of fat among urban population is very high compared to the consumption levels of rural/tribal population.

Conclusions

- High intake of sugars correlated with the high prevalence of overweight and obesity and high intake of fat is significantly associated with high prevalence of diabetes. There is a need to control the consumption of sugar, salt and fat among all the population groups, more focus may be given among urban population.
- Sugar consumption levels among rural and urban population was less than the suggested levels of ICMR (30g/CU/day).
- However, salt consumption levels among rural, tribal and urban population was higher than the suggested levels of WHO (5g/CU/day).
- Fat consumption levels significantly higher among urban population, while in case of rural and tribal population it was within the suggested levels of ICMR (20g/CU/day)
- Especially, the proportion of people, who are consuming >10g/day salt significantly decreased their proportion over a period of time.
- The high intakes of salt is significantly associated with increase of prevalence of hypertension. Similarly, high intake of sugars correlated with the high prevalence of overweight and obesity and high intake fat is significantly associated with high prevalence of diabetes.
- High intake of fat is also significantly associated with more body fat percent and overweight and obesity.
- There is a need to control the consumption of sugar, salt and fat among all the population groups, more focus may be given among urban population.

Figure 8: Prevalence (%) of hypertension and salt, diabetes and fat & overweight and obesity and sugar (g/day) consumption levels



Q & A

1. **Query from Dr. Himanish Das:**

   How visible fat is calculated? Salt consumption data is taken for all seasons?

   Response from Dr A. Lakshamiah: Consumption of Fat, Salt and sugar has been calculated based on 24 hours recall method. In few households information on total purchases have also been collected for cross validation. This data correlate with the 24 hours recall. The entire study was carried out in all seasons in a huge number of individuals (40,000), the mean intakes will not be differ any seasonal variations.

2. **Query from Major General (retd.) Dr.R. K. Marwaha:**

   Many factors affect hypertension, whether any longitudinal studies have been done to study the impact of reducing salt intake and effect of blood pressure. Study done by Dr. Marwaha on school going children have shown that overweight is the tune of 15-20% and obesity is 5-7%. Are you aware of any study on children suffering from NCDs and overweight and obesity and impact of salt intake on their Blood Pressure?

   Response from Dr A. Lakshamiah: Yes, NIN has been conduct one intervention study i.e., risk reduction for hypertension for 3 years by focusing on multi-component health and nutrition education, which includes:

   a. Counselling for increasing physical activity.
   b. Reduction of fat, oil and salt.
   c. Healthy nutrition habit.

   The ICMR funded study covering 11 states and population sample of 3000 in each state. Final impact evaluation is going on but results have not yet come. Base line as well as intervention is there and the impact of reduction in salt, sugar and fat on blood lipids, hypertensions and blood glucose may be observed. The results will come out by August 2018.

3. **Query from Ms. Ankita Marwaha:**

   Whether 24 hours recall reveal the source of salt, sugar and fat in the diet?

   Response from Dr A. Lakshamiah: Yes, these have been studied.
   The major contribution of sugar is tea and coffee and other sweets. Most of the fats are from junk food in urban population.

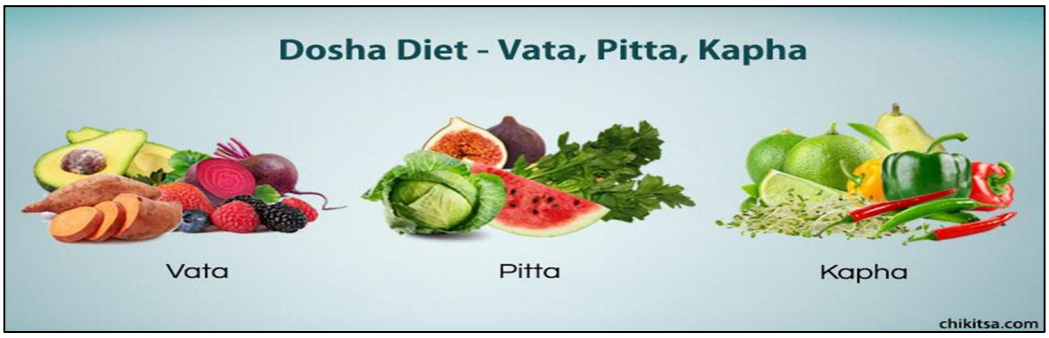
Use of Artificial Intelligence in Optimizing Nutrition

Dr. Shaji Krishnan, TNO, The Netherlands

Nutrition, the organic process in which a human assimilates food and uses it for growth and maintenance needs adequate disciplining. A rugged nutritional discipline increases disease incidence. Modelling nutrition for personal diet advice is a hard task. However, with the use of computers, this task is becoming manageable and successful. Today, the number of computer applications that model the nutrition disciplining task and offer personalized diet advice is growing fast. Amongst others, the developments in artificial intelligence (AI) and increase in biological systems knowledge in the last decade have been the major fuels to the growth in diet advice systems and services.

The earliest example in personalized nutrition is from India. Around 3000 years back in India Ayurveda prescribed diets based on body mechanism. Ayurvedic diet incorporates nearly all the natural ingredients that have the positive influence throughout the body.

Figure 9: Dosha Diet - Vata, Pitta, Kapha



The general objectives of the menu planning are recognized as achieving: palatability, nutritionally balanced and economical diet. Menu planning with a computer began in 1960s. For this purpose, Linear Programming, a class of mathematical optimization methods that determines the best outcome given certain requirements, were used. However, until 90's computer-assisted menu planning were not very popular. Human experts consistently outperformed computers.

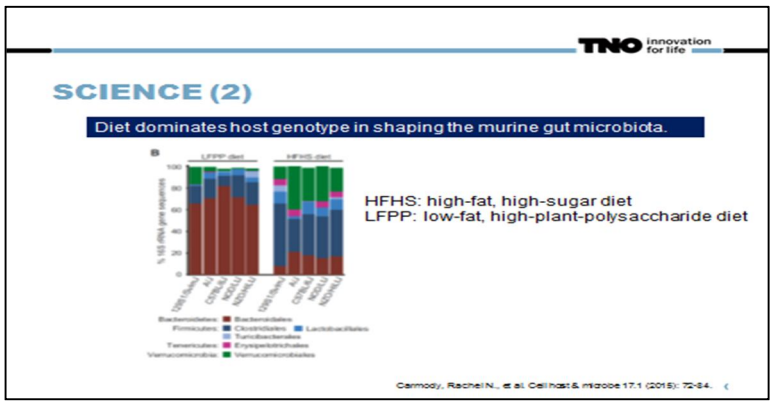
In the 1990s “expert system” evolved. This is Artificial intelligence (AI) system in a small way that attempts to model the menu planning processes of a human expert. It involved knowledge put in a computer and use on a case by case basis. Decision making were majorly: cases-based reasoning and rule-based reasoning. Information on database of foods, case-base of menus (dietary guidelines) and nutritional risk indicators were used and adapted to meet

personal preferences and nutritional needs to recommend menus. Later on, diet advice based on health state and health goals were added. However, the “expert system” had limitations and was not suitable for personal dietary advice.

Role of AI in Nutrition

Same dietary advice cannot be given to two individuals as research has shown that people eating identical meals present high variability in post-meal blood glucose response and diet dominates host genotype in shaping the murine gut microbiota (Figure 1). Diet controls microbiome and microbiome controls diet.

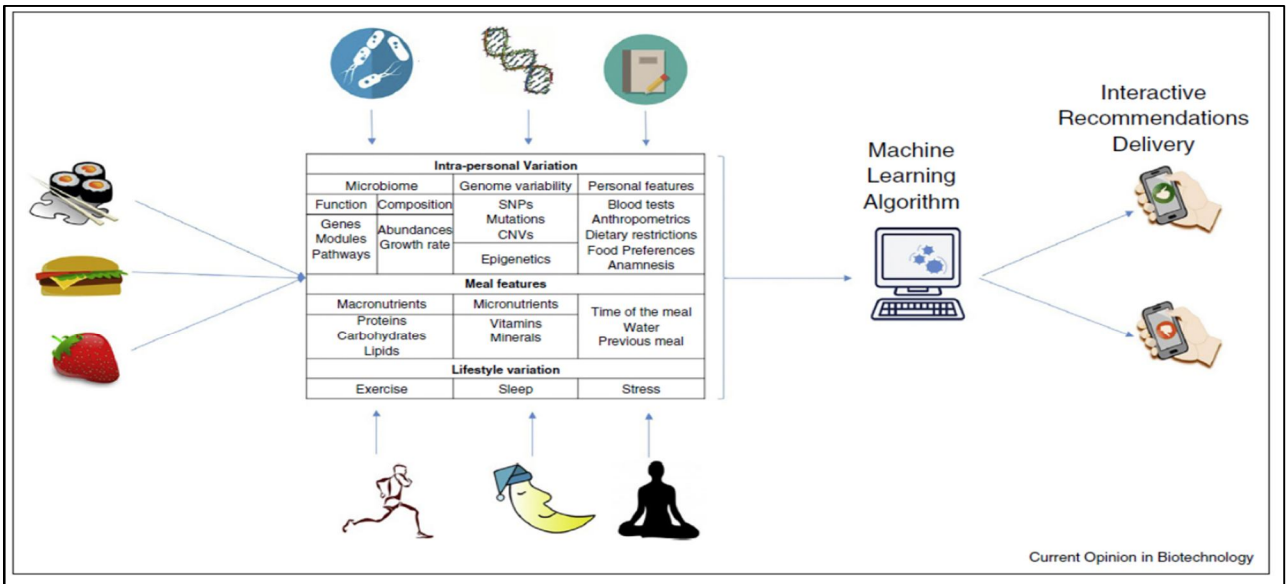
Figure 10*: *Diet dominates host genotype in shaping the murine gut microbiota



The goal of AI is to mimic the working of a human brain. AI methods attempt to create a virtual brain on a machine. An AI enabled machine learns from experience (examples) and takes appropriate decision when presented with similar examples. This is called Machine Learning. Artificial Neural Network (ANN) is an example of an AI method. Deep Learning, a variant of ANN’s is one of the powerful AI methods today.

Each one of us carry a unique metabolic signature depending not only our genomic make up, but also factors like the consortium of the microbiome we host in our gut, the environment we are exposed to, the socio-economic factors, life-style, etc, To be able identify that unique metabolic signature requires collection and analysis of billions of individual’s bio-molecular data. It is here that an AI is used. Billions of data point is monitored using AI right from conception throughout lifecycle. Humans cannot process this. AI complements the knowledge gathered in human biology in last decade in building some of the states of the art nutritional diet advice systems and services. Science along with AI is used for giving dietary advice. One such scheme is shown in Figure 2. Today’s AI methods/algorithms crunch voluminous data and discover patterns, relationships among data variables, and in this process the teach themselves too.

Figure 11: Science and AI in providing dietary advice



Rationally designed personalized dietary approaches determine the effects of numerous parameters on diet response (e.g. microbiome composition, genome variability, personal lifestyle, medical metadata). Machine learning algorithms utilize these comprehensive data sets to deliver dietary recommendations.

AI helps in optimizing personalised nutrition advice. Precision nutrition aims to prevent and manage chronic diseases by tailoring dietary interventions or recommendations to one or a combination of an individual's genetic background, metabolic profile, and environmental exposures. At TNO personal nutrition is part of a personal health package. Personalized nutrition is:

- It is personal.
- The intervention or advice is based on a diagnosis.
- A (science based) model is used to translate diagnosis into advice.
- The model is tailored to specific conditions and goals from a large toolbox.
- The tool box is continuously and systematically updated with all relevant scientific knowledge.
- Exploit/use information from large number of personal health data.

However, there is a need to exercise care as several commercial companies have started to market personalised nutrition assessment and treatment based on genotypes, but the benefits of such approaches on improving diet quality and health outcomes have not been demonstrated.

Major Conclusions

- AI assist in increasing and applying our current knowledge in science.
- Science based models augmented with the number crunching power of AI must drive nutritional research (health advice: dietary).
- Precision medicine is to become a reality soon (AI on a chip is available today).

Q & A

4. **Query from Dr. B. Sesikeran:**
   Whether AI can differentiate between good data and bad data

   Dr. Krishnan: Qualification is done by humans and it is part of validation process. Bad data gets eliminated. The system is being improved all time.

5. **Whether personal data is collected?**
   Response from Dr. Krishnan: Experiments are done using individual information. RNA is used to identify Microbiome. One single organization cannot collect all the data. Huge studies are being conducted by number of groups / consortium and data generated is accessible worldwide. More than 45, 000 experts involved in Europe alone.

6. **Query from Dr. Bhavna Sharma:**
   Whether Aps are doing the job?

   Response from Dr. Krishnan: Aps are not working well as they identify groups and the advise is based on group data and this may not work at individual level.

7. **Query from Dr. Kamala Krishnaswamy:**
   All studies are based on epidemiology which takes into account variation. Microbiome is also included here. How AI will help?

   Response from Dr. Krishnan: Diet is an agent like drug. Once we understand mechanism then diet can be recommended.

Understanding Emerging and Innovative Technologies in the Era of Smart Data and Bio-inspired Engineering for Nutrition

Dr. Ralph Graichen, Director Food and Nutrition
A*STAR, Singapore

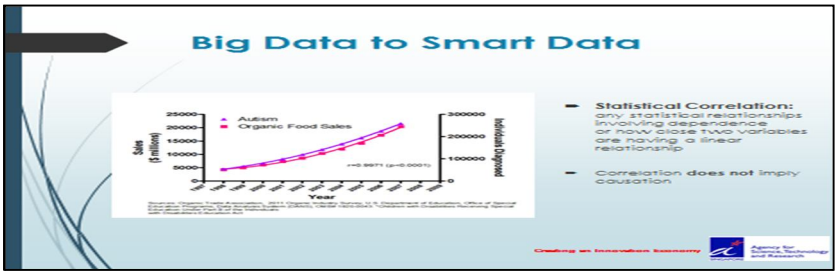
Big data refers to data sets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyse. 90% of all data has been generated in the last 2 years. Big Data is getting the next frontier for innovation in the food value chain. The sheer volume of data managed and generated every single day, which in itself is defining the term "Big Data", is a global phenomenon. It is bringing considerable challenges to organizations, shortage of talent and infrastructure are only the beginning. On the other site, Big or rather "Smart" Data are already paying significant dividends for many industries and are now more and more readily applied in food science, food safety and in securing the supply chain.

- 5 billion mobile phones in use in 2010
- 30 billion pieces of content shared on Facebook every month
- 40% projected growth in global data generated per year
- $300 billion potential value to US health care
- € 250 billion potential value to Europe's public sector administration
- 60% potential increase in retailer's operating margins
- 1.5 million more data-savvy managers needed in the US

Amount of data is becoming so large or complex that traditional data processing applications cannot deal with them anymore. We have progressed from bytes to zetabytes. 110 million network nodes were installed in 2015 with 30% projected increase per year.

Importance is being attached now to Smart Data.

Figure 12: Big Data to Smart Data



Many statistical tests calculate correlations between variables and when two variables are found to be correlated, it is tempting to assume that this shows that one variable causes the other. However, correlations must be confirmed as real, and then every possible causative relationship must be systematically explored. Causality is very important. It is here that Smart Data comes into picture. What are Smart Data providing? They offer increased opportunities in better decision making, they help to uncover underlying trends (from consumer, to operational issues, to innovation). Correlations and relationships are emerging that would typically not be available in one dimensional, unstructured data sets. Smart data are not only valuable in the space of consumer insights and market trends, smart data are now seen as a driver of growth and innovation, used to screen for new functionalities and novel features and will help drive food security and safety. Some examples of their use:

- The Consortium for Sequencing the Food Supply Chain (SFSC) will examine the global food chain - from farms, transport, processing facilities and distribution channels to restaurants and grocery stores - and apply genomics and analytics techniques to mitigate food borne illness and other risks in food management.

- Knowing the geographic areas that pathogens are typically associated with can be a powerful tool in tracking down the root source of contamination for a food product, **especially multi-ingredient food products** whose ingredients come from different states or countries.

- A potential powerful industry tool for monitoring ingredient supplies, the effectiveness of preventive and sanitary controls, and to develop new rapid method and culture independent tests; to determine the persistence of pathogens in the environment; to monitor emerging pathogens; and as a possible indicator of antimicrobial resistance.

- Identification of food frauds.

- Blockhain is another useful development. It has tremendous scope for securing food supply chain and providing food safety. It keeps history of all transactions and prevents manipulation of transactions. Blockchain based ecosystem for the food supply chain combines high-tech sensors, blockchain protocol and smart contracts. BlockChain is a useful tool in managing the supply chain and is useful for growers, suppliers, processors, distributors, retailers, regulators and consumers. This can serve as a source of truth. It provides information on:

- Origin and state of food for their transactions.
- Sustainability and traceability.
- Authenticity and Fraud.
- Verifiable sensor data.
- Governance of contracts.
- Billing and invoicing.

- Data Mining, computational analysis can be used to explore nutrients such as proteins, for functions and nutrient density and screening for molecular properties like :
    - Protein Yield.
    - Thermal Stability.
    - Physical Stability.
    - Physiological Function.
- Investigating the molecular basis of food flavours and textures.

Nutrition Driven Food Processing – *More from Less for More*

V. Prakash, Ph.D, FRSC
Vice-President of International Union of Nutritional Sciences (IUNS)
President, International Society of Nutraceuticals, Nutritionals and Naturals (ISNNAN), India
Chairman, India Region of European Hygenic Engineering Design Group, Germany
Former Director of CFTRI & Distinguished Scientist of CSIR – India

The Role of Food Science and Food Technology in the Value Addition Chain is well established through Primary, Secondary, Tertiary and Quaternary unit operations. Such value addition steps depend on individual Agri Commodity and generally do not take into account nutrition retention and value addition ! This demands different approaches and technologies and different unit operations all together a revolutionary approach from pre harvest to harvest to post harvest to transportation, storage and value addition in the chain to retain what Nutrition the commodity has inherent in it and can also be enriched by the time it reaches consumer. Thus the technology driven food products which now mainly focuses on the logistics and the multiplier effect of the product profit ultimately will reach the consumer with decreased Nutrition !? Is this right ??

In this chain who worries about Nutrition ?!! Is it ILSI ? Is it FSSAI ? Is it CSIR ? Is it Codex ? Is it the Nutrition Societies or Dieticians ? Does it come from Manufacturers ? Or is it driven from an external agenda internalizing through slogans of under nutrition !? Perhaps all and even More ! However the only way that a product reaches a consumer is through Food Industry apart from public catering, restaurants, Airlines and Railways, hospitality Industry, hospitals and Street foods and eating out including and more so the mid day meal for 12 Crore Children in India every day. The basic thing of the kitchen at home is a forgotten agenda in Nutrition. This involves a lot of networking and to change the existing individual steps in the chain to either retain the nutrients that are already present in the Agro material or in many cases fortifying to offset processing losses and enhance nutrition at the terminal end of the material which is kitchen. This is the challenge that the industry is concerned about more than addition or retention of Nutrients at what Cost !? Right so since todays awareness of health and wellness has never been so high in public with the consumer ready to pay higher cost if the product has enhanced nutrition naturally or fortified. However, in the time line food in the delivery chain even if 100% safe but gets perhaps partially

sterile Nutritionally after extreme conditions of cooking or processing, storing, added additives etc.

Not all foods belong to this category but to a large extent how do we get more nutrition spending less money and less energy to enhance quantum level of nutrition through food products. (currently only packed foods come under regulatory) is the sword hanging on the consumer for more than 70 years. This with the mix of fresh, semi processed and fully processed foods to give that nutrition as per RDA an adequate amount of nutrients for better body functions as well as brain functions from pediatrics to geriatrics can be the mandate. This is claimed to be achieved using less resources to deliver more conserved Nutrition and also enable fortified nutrients to reach the mouth. These foods are the need of the hour and the daily in take of many foods especially the rural population in India and more so the consumer in the urban and semi rural population in urban conglomerates as well as in the high rise urban elite destroying that vital Nutrition due to extreme processing or cooking. This mainly happens due to lack of knowledge of Chemistry at a fundamental level many a times even with professionals or even Scientists do not link Chemistry to Nutrition and Vice-Versa. This has to be addressed. Hard core chemists should be made to get interested in Nutrition and Physiology at a molecular level to get more from less for more (for example: Nano technology and Bioavailability nutrients, water structure and chelation of anti- nutritional factors etc.).

Therefore this is a timely seminar by ILSI India and shall alert the food industries to focus more on the agenda for retention of nutrients in high end unit operations just like minimizing the carbon foot print with the nutrition facts getting maximized and there is that the label on my talk as "More Nutrition from less Carbon foot print for more health and wellness (More from less for more")

"Integrated approach is the key to success. Traditional Knowledge + Modern Scientific Support + Rich Epidemiological data in Countries like India and Reverse Pharmacodynamics for FS&T - Nutrition based approach is the key to success using FS&T for More from Less for More."

Dr V Prakash