

- Identifying suitable employment opportunities in the field of making ornaments, processing fruits, vegetables for adding value addition and marketing.
- To give more awards, honours and recognition for women.
- Diversification of food baskets to tackle malnutrition problem.
- Fodder production with technological interventions to be taken up by rural women.
- Organizing lecture series on different issues of science and technology with the support of NASI in the state.
- According to the feedback of the participants arrange for more lectures on women empowerment, conduct work-

shops in rural areas, promote women employment-generation programmes and women awareness in rural areas, etc.

- Uttarakhand falls in the fragile ecosystem, and biodiversity conservation and management need special plans. The bioresources available may be used in a sustainable manner, so that balance between development and nature can be maintained. It is felt that taxonomy and ecological studies should be strengthened in the region, so that precious bioresources can be inventorized and conserved.
- The UCOST–NASI partnership has worked well. The local chapter of NASI in the state has accomplished many pro-

grammes. The programmes can be expanded to cover more women and children in the region, especially in rural areas.

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MEETING REPORT

Advanced glycation*

Advanced glycation end-products (AGEs) are the end result of a chain of chemical reactions involving an initial glycation reaction. AGEs are formed endogenously when the carbonyl groups of reducing sugars nonenzymatically react with the free amino groups on proteins. Intermediate products in the formation of an AGE are known as Amadori, Schiff base and Maillard products, named after the researchers who first described them. The glycation reaction is divided into early and advanced phase reactions: the former covers the reaction progression up to the Amadori rearrangement and the latter covers the reaction through the subsequent alterations of oxidation, dehydration, condensation, and so on, eventually generating AGEs. AGEs are generated *in vivo* as a normal consequence of metabolism, but their formation is accelerated during ageing and ageing-related diseases. AGEs are well known for their formation in diabetes, but also occur in many other disease processes. Glycation has been implicated as a strong contributor to many progres-

sive diseases of ageing, including diabetes, cardiovascular diseases and neurodegenerative conditions. The clinical implication of glycation in relation to metabolic disorders is slowly emerging with the advancements in analytical technologies, including mass spectrometry. The evolving situation is an excellent example for 'chemical biology meeting medicine' and this opens up vast avenues and opportunities for multidisciplinary and trans-disciplinary research collaboration among biologists, chemists, nutritionists, physician scientists and many others. To explore and stimulate the above research collaboration in the 'Year of innovation', a one-day seminar was organized recently.

The deliberations in a nutshell are presented here: At the outset, M. Balasubramanyam (Madras Diabetes Research Foundation (MDRF), Chennai) gave a plenary talk on 'Advanced glycation in diabetes – where too much advancement has disadvantaged AGEs'. He explained how clinical diabetes is advancing with glycation measurements. Two of the most well-known Amadori products are haemoglobin A1c (HbA1c) and fructosamine, the former being the gold standard diagnostics of glycemic control worldwide and the latter a measure of glycosylated proteins reflecting the blood glucose levels for the past two to three weeks.

Citing the results of the landmark studies, viz. the Diabetes Control and Complications Trials (DCCT) and the Epidemiology of Diabetes Interventions and Complications (EDIC), he pointed out that vascular complications often persist and may progress despite improved glucose control, possibly as a result of prior episodes of hyperglycaemia, a phenomenon typically referred to as 'hyperglycemic memory'. Increased AGEs are one of the underlying causes of hyperglycaemic memory. While he remembered and saluted the contributions of Maillard (the Centennial discovery), the so-called Maillard reaction and the browning of food during cooking which is used to enhance the quality, flavour, colour and aroma of the diet, he stressed that it is equally important to realize the health consequences of these Maillard products and AGEs, both endogenous and exogenous. Apart from endogenous AGE formation, AGEs and their precursors are also absorbed by the body from exogenous dietary sources (referred to as 'dietary AGEs') as a result of consumption of highly heated processed foods. Exclusive dAGE database has been developed in the West and this has been used as a valuable instrument for estimating dAGE intake and for guiding food choices to reduce dAGE intake. Pointing out this, Balasubramanyam also stressed the need

*A report on the one-day seminar (held on 30 September 2013) on 'Advanced glycation – where chemical biology meets medicine'. The seminar was organized by the Division of Biochemical Sciences, National Chemical Laboratory, Pune.

for developing dAGE database in India, a population with diverse food choices which is also more prone to insulin resistance, type-2 diabetes and cardiovascular disease. He added that research is underway at MDRF to develop such a database. While there is much more hope in developing non-invasive, point-of-care (POC) devices for glucose monitoring, he showed potential of a POC device which non-invasively measures the skin collagen AGE fluorescence that was successfully demonstrated as a population screening tool for diabetes. He also reviewed the clinical utility of the glycation reactions, including the recent attention on glycated albumin and other metabolite measurements. Finally, citing the inhibitory action on AGE formation by metformin (the first-line treatment drug for diabetes – whose origination is from *Galega officinalis*), he emphasized that there is an imperative need for bio-prospecting our natural plant resources and herbal treasures for the development of novel and specific inhibitors of AGEs.

D. S. Reddy (National Chemical Laboratory (NCL), Pune) gave an overview on 'Chemistry of AGE inhibitors and breakers'. He discussed details of chemi-

cal reactions that lead to accumulation of AGEs, potential sites of intervention to inhibit AGEs, and some known AGE inhibitors. Further, the chemistry of AGE inhibitors, including monoreactive carbonyl quenchers, dipeptides, guanidine derivatives, metal chelators and anti-hypertensive drugs was discussed. In addition, Reddy also emphasized on the naturally occurring AGE inhibitors such as epigallocatechin, flavones, etc.

Vikram S. Ghole (National Institute of Virology and University of Pune, Pune) presented his work on the 'Effect of herbal chemicals on the processes of glycation using goat lens as a model system'. He shared his experience on how herbal drugs like *Gymnema* extract and Diabecol reduce glycation-induced lens opacity. Ghole also discussed the influence of a novel biphenyl compound, VMN2 on streptozotocin-induced diabetic nephropathy in rats.

Rashmi Tupe (Bharati Vidyapeeth University, Pune) spoke on 'Glycation – an imperative target in diabetes and complications'. She emphasized on the role of nutraceuticals and micronutrients such as zinc in alleviating AGE-associated complications. She also discussed the role of

glycated albumin and RAGE (receptor for advanced glycation end-products) signalling.

Finally, Mahesh J. Kulkarni (NCL; also the seminar coordinator) discussed various 'Chemical and biological strategies to reduce AGEs' and exposed the technological advancements and biomarker potential in glycation measurements to the august gathering.

The key issues and challenges in the area of protein glycation that emerged from the various plenary and technical sessions formed the subject matter of the panel session. After thorough brainstorming, several collaborative research possibilities were discussed central to proteomics and metabolomics aspects of diabetes, its vascular complications and other metabolic disorders.

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