NRIPENDRA CHANDRA GANGULI

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NRIPENDRA CHANDRA GANGULI

(1927-2009)

Elected Fellow 1980

CHILDHOOD AND EARLY EDUCATION

NRIPENDRA CHANDRA GANGULI was born on the 1st of August 1927 in Churain Village near Dacca now in Bangladesh. His parents were Dr Ham Chandra Ganguli and Manorama Ganguli. He had two sisters. Ganguli had his schooling in Lal Jubilee School, Dacca (1935-1942). He did applied chemistry in Dacca University and took his BSc (Hons) in 1947. He obtained his Master of Science in Applied Chemistry from Calcutta University in 1949 and his Doctor of Science from the same University in 1955. He married Dipali Ganguli on the 20th of July 1956. He has two children (daughters) Shabari and Sharmila.

POSITIONS HELD

Under the Indian Wheat Loan Educational Exchange Programme, Dr Ganguli was sent by the Government of India to the Department of Agricultural Biochemistry, University of California at Berkeley, USA between 1956 and 1958. During this period he has gathered research experience in Agricultural, Protein and Enzyme Chemistry. He joined as Associate Professor in Biochemistry at the National Diary Research Institute, Karnal in 1961 and worked till 1963. He took over as Diary Biochemist in 1963 and continued in that capacity till 1968. He became Professor and Head of Division of Biochemistry in 1968 and worked in that capacity till 1978. He served as Director, National Diary Research Institute from September to December 1977. He became Professor of Eminence in 1978 and continued in National Diary Research Institute till 1982. He continued as Senior Professor of Biochemistry from 1982 till his retirement. After retirement, he was a Consultant to Dabur India (Delhi) and KC Das Pvt. Ltd, Bangalore.

MAJOR ACHIEVEMENTS

Dr Ganguli has carried out extensive investigation on the Chemistry of milk proteins, notably on the different fractions of buffalo and cow caseins which have elicited the fundamental differences between these two. In the course of these studies, simple methods of separation of casein fractions by starch gel electrophoresis, estimation of proteose peptone in milk, turbidimetric method of rennet assay etc. were developed. Incorporation of radioactive amino acid in milk

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protein in freshly secreted milk was demonstrated. His work has received international appreciation. He has published more than 100 papers and has written a monograph on Milk proteins. He built up an active school of research workers in NDRI, Karnal. He was the Editor of the *Indian Journal of Diary Science*.

RESEARCH WORKS

Dr Ganguli engaged himself on elucidating the fundamental structure of milk proteins, differentiating proteins in milk from different species of animals, behaviour of milk outside the udder and towards rennet and allied topics., as a result of which he contributed to widen the knowledge regarding proteins in milk, as well as, in finding a plausible explanation for the behaviour of milk during manufacturing processes. He proposed a new approach to the study of milk proteins. He built a band of enthusiastic workers who did pioneering work in this field. His work has been internationally recognized as evidenced by references to his publications by protein scientists.

Through concerted endeavour and systematic and precise analytical approach it was possible for Dr Ganguli to unveil certain basic differences in milk proteins from buffalo and cow. Convincing data were accumulated to establish the differences in chemical structure on biochemical behaviour of proteins from different species. A sequential delineation of these is as follows:

(a) Composition Difference

Caseins prepared from milk of buffalo and cow differs in the make up as illustrated by distinctive fractions comprising of whole casein. Buffalo milk casein contains more β-fraction than the α-fraction whereas in cow casein it is the reverse. This was detected by subjecting these proteins to electrophoresis.

(b) Difference in Sugar Levels

Casein is known to contain a specific sugar, *viz.* sialic acid in bound form. This sugar is of specific significance in diary technology because of its role in rennet action. Dr Ganguli established that sialic acid of buffalo milk caseins was significantly lower as compared to cow's milk. Similarly it was demonstrated that goat's milk protein contains less sialic acid than buffalo caseins.

(c) Action of Rennet

When rennet clots milk, it induces a distinct transformation in casein fractions. The k casein is being specifically attacked by rennet releasing a glycopeptide containing sialic acid from this protein. Dr Ganguli demonstrated that buffalo milk casein behaved differently towards rennet than that of cow's milk casein. Critical studies point to convincing evidence that the rate of release of glycopeptide from k casein by

Rennet was slower in buffalo than in cow. Although buffalo's milk clots faster than cow's milk due to its high calcium content. Due to such differences in Rennet action, reactions in a cheese vat would follow different rates in buffalo and cow's milk. Under similar conditions of rennet clotting, cleaving of k casein was shown to proceed slowly in buffalo's milk as compared to cow's milk.

Dr Ganguli evolved a procedure by which one can distinguish rennet preparations isolated from either animal, vegetables or microbial source by a casein – agar plate assay method. This method has enabled to identify the type of rennet even in a mixture. The differential behaviour of rennet from that of other proteolytic enzymes like trypsin on casein has also been established by Dr Ganguli on the basis of the release of sialic acid in free or bound form from casein after the action of these enzymes.

For the first time Dr Ganguli standardisd a procedure for assaying rennet by an optical method using micellar casein. This method has now enabled the estimation of rennet activity with greater accuracy since the existing procedure is to evaluate rennet from its milk clotting time which is not so precise and accurate. He propounded a new concept in the mechanism of rennet action on casein. He could demonstrate the release of intermediate product like proteose before the final appearance of glycopeptide from k casein

(d) Digestion of Milk Proteins

Dr Ganguli showed that buffalo milk casein was degraded at a slower rate than cow's milk casein although the amino acid make up of these two caseins did not differ much. The number of peptides released through such digestion was less in the case of buffalo milk casein as compared to cow's milk. The electrophorestic properties of the released peptides and digested caseins were also different between cow and buffalo milk caseins.

(e) Status of Micellar Casein

In milk, casein exists in two forms, micellar casein, as it exists in suspension, contains distinct proportions ki and Bi caseins along with calcium magnesium which mainly contribute to milk stability (white colour of milk) The other is soluble casein can be separated as micellar casein from milk by ultracentrifugation at high speed. He demonstrated that these casein particles are different in their size in buffalo and cow's milk. Casein in buffalo milk was mostly in micellar form whereas Cow's milk contains both micellar and soluble forms of casein. Buffalo milk exhibits difference in relation to opacity, rennet action, heat treatment and solubility as compared to cow's milk caseins.

The micellar casein from milk of different breeds of cow were also demonstrated by Ganguli to differ in relation to rennet reaction. The release of sialic

acid from micellar casein by rennet were also established to be faster than the acid casein, which is another observation of significance. On the basis of this differential susceptibility of micellar casein from acid casein, he could evolve a turbidimetric method for assaying rennet. It was also shown that micellar casein has a slower electrophoretic mobility as compared to acid casein of the same milk.

(f) Radio Isotopic Studies

Using C^{14} labelled amino acid, Dr Ganguli could demonstrate a new enzymatic activity of freshly secreted milk which is capable of incorporating the labelled amino acids into milk protine complex. This is a unique property revealed by Dr Ganguli. He propounded a new theory on the enzymatic formation of the casein micellar in milk. The studies on the incorporation of P^{32} into different subcellular levels of mammary gland and liver tissue of rabbits and rats carried out by Dr Ganguli has provided data eliciting the basic difference in the metabolic patterns of these tissues. The role of ovarian harmones in the synthesis of milk proteins and nucleic acids by mammary gland of rat was confirmed through the radio isotopic studies.

GENETIC POLYMORPHISM IN MILK PROTEINS

It was also established that the appearance of components of casein is controlled by the genetic factor and is an inherited process. A significant difference in the presence of k-casein component in the milk of cow and buffalo was also established. Cow milk contains the genetic species of k-caseins either singly or together whereas buffalo (Murrah breed) contains both the genetic species of k-caseins together. To establish this phenomenon, Dr Ganguli evolved a modified method of starch gel electrophoresis using Petri dish as gel support.

PROTEOSE-PEPTONE IN MILK

Proteose-peptone, a minor fraction in milk, was well charecterised by Dr Ganguli. A simple and satisfactory method was developed for its estimation in milk colorimetrically. The amino acid composition, N terminal amino acids, hexose and sialic acid contents of proteose peptones were established. The molecular size and heterogeneity of proteose peptone of milk were determined using analytical ultracentrifuge, Syphadex gel filtration and starch gel electropheresis. A heat induced interaction between proteose peptones and casein of milk was reported. The release of proteose peptone like material in milk due to trypsin action on milk proteins was observed. The level of proteose peptone in milk products like condensed milk, milk powder, sterilized milk and cheddar cheese were ascertained.

Addition of proteose peptone in condensed milk was established to stimulate age thickening properties with the period of storage. This is of significance in the preparation of condensed milk products in relation to the initial level of proteose

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peptone in milk. Certain minimum level was prescribed for milk for ascertaining its suitability in the preparation of condense milk of good quality. The fraction in milk was also shown mammary origin. The proteose peptone of milk, colostrums and blood of the same animal appears to have no correlation in its physicochemical properties and thereby was established to be a fraction synthesized in the mammary gland. These findings added new and valuable knowledge on this minor protein component in relation to its origin, properties and impact on the quality of milk products.

List of PhD Students

S.No.	Name of the student	Title of thesis	University	Year
1.	Guchheit	Lipid metabolism in Guinea Pigs	Calcutta	1961
2.	Minotic Nandy	Shikimic acid biosynthesis	Calcutta	1961
3.	GC Majumdar	Synthesis of proteins in milk	Agra	1968
4.	VK Joshi	Isolation and role of proteose	Agra	1968
5.	S Dommen	Casein micelle of buffalo milk	Agra	1969
6.	RS Sharma	Enzyme of buffalo milk	Punjab	1970
7.	PK Sabarwal	Micellar casein and sialic acid	Punjab	1971
8.	LN Singh	Mastitis on properties of milk	Agra	1971
9.	CK Nain	Conditions for rennet production	Punjab	1972
10.	Jose Stephen	Heat changes in milk protein	Punjab	1973
11.	Ajit Singh	Goat milk proteins	Punjab	1973
12.	RD Sammanwar	Lipase in buffalo milk	Agra	1973
13.	RN Tandon	Ghee from milk	Punjab	1974
14.	M Bhosrekar	Biochemical studies on semen	Punjab	1974
15.	AK Bandopadhyay	Protein from bufflo milk	Punjab	1974
16.	KL Bhatia	Proteins from cross breed	Punjab	1975
17.	IA Angelo	Synthesis of rennin	Punjab	1975
18.	SR Chakrabarty	Casein with amino acids	Punjab	1975
19.	KC Tandon	Sterilisation of buffalo milk	Agra	1976
20.	Sukhminder Singh	Globule membrane proteins	Punjab	1976
21.	MP Gupta	Stability of casein	Agra	1977
22.	MK Bhavadasan	Buffalo milk fat globules	Punjab	1977
23.	HF Haggag	Synthesis of mammary gland	Punjab	1978
24.	JS Khillan	Protein synthesis in mammary gland	Punjab	1979
25.	RT Ravi	Synthesis of non histone proteins	Punjab	1979

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26.	AM Mehriz	Stability of casein micelle	Punjab	1979
27.	GP Chinnaiya	Freezability of buffalo semen	Punjab	1979
28.	CN Kuchroo	Humanisation of buffalo milk	Punjab	1980
29.	PA Sarma	Reproductive tract of buffalo	Punjab	1981

AWARDS AND HONOURS

Professor Ganguli received Rafi Ahmed Kidwai Memorial Prize for Agricultural Research by ICAR in 1974. He was chosen Professor of Eminence by ICAR in 1978. He was elected Fellow of INSA in 1980. He received SC Roy Commemoration Prize in Biochemistry in 1982. He delivered BC Roy Memorial Lecture in Calcutta University in 1983. He was a Fellow of the National Academy of Agricultural Sciences, India, Indian Chemical Society and Institution of Chemists, India. He was Vice President of Indian Immunology Society and Indian Society of Agricultural Chemists. He was the recipient of CSIRO (Australia Diary Research Jubilee Award). He was associated with FAO on Radio tracer in Animal Science at the Colarado State University, USA in 1971 and codex meeting in Rome in 1972. He had collaborative Research with Michigan State University, USA, Morinage Milk Industries Tokyo, Diary Research Institute at Kempton, West Germany Madam Kuzdzal at Jouy- an-joses, France, Nestle Technical Assistance Group, Switzerland and Yamakuchi University of Tokyo, Japan.

Dr Ganguli, an outstanding scientist, who made several contributions in diary research, passed away on the 30th of May 2009.

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