IDRC-207e

cassava toxicity and thyroid: research and public health issues

proceedings of a workshop held in Ottawa, Canada, 31 May – 2 June 1982

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Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa, Canada

Delange, F.
Ahluwalia, R.

IDRC, Ottawa CA

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Cassava toxicity and thyroid: research and public health issues : proceedings of a workshop held in Ottawa, Canada, 31 May - 2 June 1982. Ottawa, Ont., IDRC, 1983. 148 p. : ill.

/Cassava/, /toxicity/, /endocrine system/, /endemic diseases/, /human nutrition/, /public health/ — /diet/, /epidemiology/, /agricultural research/, /animal nutrition/, /agriproduct processing/, /health education/, /mental retardation/, /food consumption/, /conference report/, /recommendation/, /list of participants/.

UDC: 616.441-006.5:633.68 ISBN: 0-88936-368-4

Microfiche edition available

Il existe également une édition française de cette publication

La edición española de esta publicación también se encuentra disponible

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Proceedings of a workshop held in Ottawa, Canada, 31 May - 2 June 1982

Editors: F. Delange[1] and R. Ahluwalia[2]

[1]*Assistant Professor, Service des Radioisotopes, Hôpital Saint-Pierre, Brussels, Belgium.*

[2]*Former Associate Director, Health Sciences Division, International Development Research Centre, Ottawa, Canada.*

Résumé

Cette publication est un résumé des actes d'un atelier qui a porté sur les relations entre la consommation de manioc et les troubles thyroïdiens chez l'homme. L'atelier a rassemblé des spécialistes de la médecine, de l'agriculture et de l'hygiène publique pour (1) examiner les résultats des études subventionnées par le CRDI sur le rôle du manioc dans l'étiologie du goitre endémique et du crétinisme ; (2) passer en revue les travaux de recherche sur les aspects du manioc intéressant l'agriculture ; (3) échanger des informations sur la méthodologie et les résultats d'études dans des domaines connexes ; et (4) définir les priorités de recherche et faire des recommandations touchant les programmes d'hygiène publique. La poursuite des travaux de recherche dans ces domaines contribuera grandement à prévenir et à contrôler le goitre endémique qui, par les anomalies de développement dont il est la cause constitue toujours un grand danger pour les populations des pays en développement.

Resumen

Esta publicación informa sobre las exposiciones presentadas en un seminario dedicado a la relación entre el consumo de yuca y el problema de la tiroides en los humanos. El seminario reunió científicos de los sectores médico, agrícola y de salud pública con el objeto de (1) reseñar los resultados de los estudios financiados por el CIID sobre el papel de la yuca en la etiología del bocio endémico y el cretinismo, (2) reseñar las actividades investigativas sobre aspectos agrícolas de la yuca, (3) intercambiar información sobre metodologías y hallazgos de otros estudios relacionados, y (4) identificar prioridades específicas para la investigación y hacer recomendaciones para los programas de salud pública. Los esfuerzos continuos en estas áreas de la investigación se dezicarán en buena parte a prevenir y controlar el bocio endémico y sus anormalidades acompañantes en el desarrollo, las cuales siguen constituyendo un problema serio de salud pública entre las poblaciones del mundo en desarrollo.

Contents

Cassava Diet, Tropical Calcifying Pancreatitis, and Pancreatic Diabetes

P.J. Geevarghese[1]

In recent years, evidence has accumulated to show that cassava-based diets are related to the development of tropical calcifying pancreatitis (TCP) and pancreatic diabetes (PD). This disease starts in childhood with episodic abdominal pain, followed by the development of diabetes by puberty. The patients are young and lean, having bilateral parotosis and cyanosis of the lips and face. Scout films of the abdomen often show pancreatic calcification — a diagnostic sign of chronic pancreatitis. Histopathologically, there is dilatation of pancreatic ducts and ductules containing proteinaceous calcified material, acinar atrophy, and islet cell destruction in the pancreas.

TCP and PD is seen most frequently, and in its purest form in Kerala State, India (Sarles et al. 1979), where we have studied 1700 patients with pancreatic calcification and diabetes, admitted to the Medical College hospitals in Kerala, during the past 20 years. Operative findings, pancreatograms, and pancreatic biopsy in 375 patients and 38 postmortem cases have shown that there is a distal pancreatic ductal obstruction toward its duodenal end in the majority of cases. A ductal obstruction has also been described in many cases of alcoholic calcifying pancreatitis (ACP), seen in Western countries (Warren and Hoffman 1976).

The theory of primary pancreatic ductal obstruction as a cause of ACP has been refuted recently by Sarles and Laugier (1981), who have found that a high protein - high fat diet in the presence of alcoholism induces enzyme precipitation in pancreatic ductules, and the obstruction in the pancreatic duct system is only secondary to the formation of protein plugs. However, an international multicentre study of nutrition and pancreatitis conducted by Sarles (1973) has shown that in Trivandrum, Kerala, the protein intake of patients with TCP was comparatively low and that calcifying pancreatitis was common. Therefore, we looked for other dietetic factors that can cause pancreatic injury in the presence of protein deficiency. A high carbohydrate content in the diet might also cause precipitation of enzyme proteins in the pancreatic juice. This is supported by the observation of Sarles et al. (1979) that in centres of southern Europe, e.g., Marseille, France, the intake of carbohydrates was 429 ± 115 g/day in patients with ACP and the pattern of pancreatitis was of the calcifying type, whereas in northern Europe, e.g., Copenhagen, Denmark, where acute pancreatitis is more prevalent, the carbohydrate intake was only 290 ± 69 g/day. In our calcifying pancreatitis patients in Kerala, the intake of carbohydrates was high, 478 ± 100 g/day. The source of this carbohydrate, peculiar to Kerala, was found to be cassava. Cassava is rich in carbohydrates and poor in protein content. In addition, the presence of cyanogenic glycosides in cassava would cause further protein deficiency because sulfur-containing amino acids, such as methionine and cysteine, already deficient in cassava, are required for cyanide detoxification.

Epidemiological data in support of cassava as a cause of TCP show that this disease is most prevalent in countries such as Nigeria (Osuntokun 1970), Uganda (Shaper 1964), India (Geevarghese 1968), Indonesia (Zuidema 1959), and Brazil (Dani and Nogueira 1976), where cassava is eaten and the incidence of endemic goitre related to cassava toxicity is also common. That diabetes mellitus is more common in people eating cassava-based diets has also been pointed out by Davidson et al. (1969) who reported a 1% incidence of diabetes in inhabitants of Kalene Hill, Zambia, where people consume 340 g of carbohydrates per day in the form of cassava, making up 93% of their total caloric intake; whereas in areas of the adjoining coun-

[1]46/1583 Sivarama Menon Road, Cochin, Kerala, India.

tries, i.e., Malawi and Zimbabwe in Central Africa, population surveys have shown the incidence of diabetes to be only 0.1–0.13%.

The experimental evidence (Pushpa 1980) in support of cassava-based diets as a cause of TCP is that rats on a diet containing 22.8 g of cassava containing 73 mg/g cyanide and sacrificed at 18 months showed pancreatic changes such as dilated ductules, papillary infoldings, eosinophilic material in ductular lumen, round cell infiltration, and atrophic acini as is seen in TCP.

McMillan and Geevarghese (1979) have shown that administration of cyanide (KCN), orally or intraperitoneally, to rats caused a peaking of plasma glucose up to 300 mg/dL within 30 min. This was associated with temporary glycosuria. After ingesting KCN for 1 month, the chronically cyanide ingesting rats developed a dusky colour of the fur somewhat similar to the cyanotic hue of the lips seen in our patients with TCP, possibly due to sulfur amino acid deficiency. It is possible that during the process of cyanide detoxification in the body, the pancreas, which has a high turnover of protein in the body, is affected if there is a deficiency of amino sulfur, as in cassava-based diets.

Although there is a high incidence of both endemic goitre and TCP in Kerala, where cassava is consumed in amounts varying from 100–300 g/day, making up 60% of caloric intake and 73% of carbohydrate intake, the two diseases are rarely associated. We have observed that goitre is more prevalent in better nourished individuals, whereas TCP is common in the undernourished. The incidence of goitre has remained steady over the past 10 years in the major teaching hospitals of Kerala, whereas TCP is declining. This is probably due to the increase in protein consumption of Keralites over the past decade as a result of the increased availability of fish, which is consumed with cassava. It is presumed that with protein deficiency the pancreas is affected; on the other hand, if enough sulfur amino acids are present in the diet the thiocyanate that is formed as a result of cyanide detoxification causes endemic goitre.

In summary, it may be stated that the high carbohydrate content of cassava may cause enzyme precipitates in the pancreatic ductules, causing TCP, just as a high protein – high fat diet is responsible for ACP. In addition, the cyanogenic glycosides present in cassava induce pancreatic injury. Protein deficiency aggravates the pancreatic damage. It is to be emphasized, however, that cassava-based diets alone may not cause TCP and PD. Other genetic factors, such as pancreatic ductal anomalies, are also present in this disease.

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