

Effect of a Brazilian regional basic diet on the prevalence of caries in rats

J.T. Pinheiro¹, G.B.L. Couto²,
M.M.V.B. Vasconcelos¹,
M.M.D.C. Melo¹,
R.C.A. Guedes³ and
M.A.C. Cordeiro¹

Departamentos de ¹Prótese e Cirurgia Facial, and ²Clinica e Odontologia Preventiva, Odontologia, Universidade Federal de Pernambuco, Recife, PE, Brasil
³Departamento de Nutrição, Universidade Federal de Pernambuco, Recife, PE, Brasil

Abstract

The aim of the present study was to determine the effect of a regional basic diet (RBD) on the prevalence of caries in the molar teeth of rats of both sexes aged 23 days. The animals were divided into six groups of 10 rats each receiving the following diets for 30 and 60 days after weaning: RBD, a cariogenic diet, and a commercial diet. The prevalence and penetration of caries in the molar teeth of the rats was then analyzed. The RBD produced caries in 37.5% of the teeth of animals fed 30 days, and in 83.4% of animals fed 60 days, while the cariogenic diet produced caries in 72.5% and 77.5% of the teeth of animals fed 30 and 60 days, respectively. Rats fed the RBD for 30 days had caries in the enamel in 38% of their teeth, 48% had superficial dentin caries, and 7.5% moderate dentin caries. The effect of the RBD did not differ significantly from that of the cariogenic diet in terms of the presence of caries in rats fed 60 days. The penetration depth of the caries produced by the RBD was the same as that produced by the cariogenic diet. Our results show that the RBD has the same cariogenic potential as the cariogenic diet. Since the RBD is the only option for the low-income population, there should be a study of how to compensate for the cariogenicity of this diet.

Key words

- Caries
- Diet
- Diet cariogenicity
- Brazilian regional basic diet

Correspondence

G.B.L. Couto
Rua Manoel Felipe Santiago, 5264
54440-110 Jaboatão dos Guararapes,
PE
Brasil
E-mail:gbosco@npd.ufpe.br

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Introduction

Tooth caries is a multifaceted bacterial disease that affects nearly 95% of the population. Its predominance is cumulative, increasing with age, especially when not controlled (1).

Results of studies carried out on laboratory animals and humans have indicated that dietary factors, especially sugar content, play a major role in the process of establishing caries (2-4). Bellagamba and Varveri (5) emphasized the importance of the increased

consumption of fermentable carbohydrates, for example saccharose, as an etiologic factor in dental caries. However, because long-chain carbohydrates such as starch are not metabolized quickly in the mouth cavity, these carbohydrates should protect against the deleterious effects of acids resulting from bacterial action.

Many local and systemic factors such as vitamins, mineral salts and hormones can modify the permeability of the tooth to aggressor agents and therefore its resistance to the formation of caries. During the develop-

ment and calcification of the tooth organ and throughout its life, nutritional imbalance can generate modifications in the tooth structures, making them more susceptible to caries (6). Studies correlating caries and nutritional conditions in Brazil have shown that the incidence of caries is highest in the low-income population (7).

Navia et al. (8), evaluating the nutritional and dietary factors that can influence the formation of caries, showed that dietary nutrients can modify microbial metabolism, salivary flow and deposits on the dental surface. According to Bhaskar (9), a nutritional deficiency can modify the formation of the enamel, leading to the occurrence of pathological amelogenesis represented especially by hypoplasia and hypocalcification.

Teodósio et al. (10) described a diet called regional basic diet (RBD), prepared with the foodstuffs that constitute the daily fare of the low-income human population in the Northeast of Brazil. Indeed, the quality and quantity of food consumed constitute a public health problem in Brazil. After collecting the data, these investigators performed a nutritional analysis of the RBD, which was found to be insufficient in content and quality of proteins, fat, calories, vitamins and minerals compared to the average diet. The RBD promotes a kind of undernutrition in the rat similar to the malnutrition observed in humans.

The objective of the present study was to evaluate the influence of a Brazilian RBD on the prevalence of caries in the molar teeth of rats when compared with a cariogenic diet and a control diet. The number and depth of penetration of the lesions was also evaluated.

Material and Methods

Sixty Wistar rats (*Rattus norvegicus albinus*) of both sexes aged 23 days, which consumed diets for 30 and 60 days after weaning, were used in this study. The ani-

mals were maintained under standard laboratory conditions and divided into six groups according to time (30 days - group A; 60 days - group B) and diet. Three types of diet were used: a commercial laboratory diet (Labina, Purina do Brasil Ltd., Campinas, SP, Brazil), a cariogenic diet and a diet prepared with the foodstuffs that constitute the daily fare of the low-income human population in the Northeast of Brazil (RBD). The percentages of the nutrients contained in the average daily amount of the cariogenic diet consumed were: 56% sugar, 28% powdered skim milk, 8% ground whole wheat, 5% yeast, 2% of a product rich in carbohydrate (Sustagem[®]), and 1% sodium chloride. The percentages for the RBD were: 24.64% beans, 44.81% manioc flour, 9.24% jerked beef, and 21.28% sweet potato. The RBD was prepared as described by Teodósio et al. (10) and, together with the cariogenic diet, was prepared in the Nutrition Department of UFPE. The control diet consisted of standard laboratory ration. The amount of ration offered daily was 150.4 g. The weight gain of each animal was recorded weekly.

After 30 days (group A) and 60 days (group B), the rats were sacrificed by ether inhalation and the mandible and maxilla were removed, washed in running water and placed in 10% formaldehyde for 24 h. The pieces were washed, dried with gauze and dissected. The molars from each hemimandible and hemijaw were sectioned along the sagittal medial-distal plane because the diet used produced predominantly furrowed caries (11-13). A steel saw disc was set into the mandrel, adapted to a contra-angle and maintained under constant cooling with running water to prevent overheating. Once cut, the pieces were stained with Schiff's reagent (14). The furrowed cavity lesions in the molars were examined by stereoscopic microscopy at 12.5X magnification and the penetration depth of the lesions was determined according to the method of Keys (15).

Results and Discussion

In the present study, groups 1A, 1B and 2B (Table 1) presented a high prevalence of caries. These groups received carbohydrates in the diet, as also reported by other investigators (5,16-20), who emphasized the caries-inducing role of an exaggerated consumption of carbohydrates. The groups receiving the cariogenic diet (1A and 1B) did not differ significantly in the prevalence of caries from the RBD at 60 days (2B). The RBD was found to have a high cariogenic power (37.5% - 2A and 83.4% - 2B; Table 1). It should be emphasized that the RBD is a deficient diet that provokes malnutrition in rats similar to the human marasmus that prevails in the northeastern region of Brazil. The present results concerning the RBD agree with those reported by other investigators (6,21-23) who reported that malnutrition can cause a rise in the prevalence of caries. Various factors may have contributed to the high prevalence of caries found with the use of the RBD, such as enamel malformation due to episodes of malnutrition (24-29), affected salivary glands (17,23,30,31), and the composition of the diet itself which, in addition to being deficient in proteins, vitamins and minerals, is

rich in carbohydrates (10). When comparing the results for different times of animal feeding, we observed that the animals fed 30 days (1A and 2A) presented caries with less prevalence than the animals fed 60 days (1B, 2B), except for groups 3A and 3B. This agrees with the results obtained by Dreizen (6), who showed that during the development and calcification of the dental organ, poor nutrition can provoke modifications in the dental structures, making them more susceptible to caries.

A high prevalence of caries in the animals that received the cariogenic diet was expected due to the fact that it was rich in carbohydrates, especially sucrose. It should be pointed out that sugar must be present for caries to appear (32).

Caries with moderate dentin penetration were found in 6.6% of group 1A teeth (animals that received the cariogenic diet for 30 days) and in 7.5% of teeth in group 2A (animals that received the RBD for 30 days). A qualitative analysis of our results evaluating the penetration of the lesions can contribute to the understanding of the cariogenic power of a diet, because only by comparing the depth of these lesions can the real influence of the diet on the caries process be

Table 1. Distribution of caries in 720 rat teeth (120 teeth per group) subjected to three types of diet for 30 or 60 days.

	1A	1B	2A	2B	3A	3B
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Enamel caries						
No caries	33 (27.5)	27 (22.5)	75 (62.5)	20 (16.6)	13 (10.8)	49 (40.8)
Caries	87 (72.5)	93 (77.5)	45 (37.5)	100 (83.4)	107 (89.2)	71 (59.2)
Superficial dentin caries						
No caries	95 (79.1)	93 (77.5)	62 (51.7)	101 (84.2)	115 (95.8)	120 (100.0)
Caries	25 (20.8)	27 (22.5)	58 (48.3)	19 (15.8)	5 (4.2)	-
Moderate dentin caries						
No caries	112 (93.4)	120 (100.0)	111 (92.5)	119 (99.2)	120 (100.0)	120 (100.0)
Caries	8 (6.6)	-	9 (7.5)	1 (0.8)	-	-

N = number of teeth. Groups fed diet for 30 days: 1A = cariogenic diet; 2A = regional basic diet; 3A = commercial laboratory diet. Groups fed diet for 60 days: 1B = cariogenic diet; 2B = regional basic diet; 3B = commercial laboratory diet.

determined. From a quantitative point of view, group 3A treated with a commercial diet presented 90% prevalence of caries, predominantly superficial. In contrast, both the RBD and the cariogenic diets produced a significant number of caries in the dentin, thereby demonstrating their high cariogenic

power (1A, 2A, 1B and 2B; Table 1). Considering the high cariogenicity of the RBD, often due to poor feeding habits and to the fact that it is hardly ever modified, it becomes imperative to find ways to compensate for the cariogenic properties of this diet, including fluoridation of drinking water.

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