

Oral implications of the vegan diet: observational study

L. LAFFRANCHI¹, F. ZOTTI², S. BONETTI², D. DALESSANDRI¹, P. FONTANA²

Aim. The aim of this study was to investigate oral changes in subjects who have assumed a vegan diet for a long time (at least 18 months), that is to say, a diet completely lacking in meat and animal derivatives.

Methods. A sample of 15 subjects was analyzed, all from northern Italy and aged 24 to 60 year, composed of 11 men and 4 women who had been following a vegan diet for a minimum of 18 months to a maximum of 20 years. In parallel with the study sample, a control group (15 subjects) with the same criteria of age, sex, and place of origin all following an omnivorous diet was chosen. The sample answered a questionnaire that investigated their eating habits, the frequency with which they eat meals, the main foodstuffs assumed, oral hygiene habits, and any painful symptomatology of the teeth or more general problems in the oral cavity. The sample was then subject to objective examination in which the saliva pH was measured and the teeth were checked for demineralization of the enamel, white spots, and caries (using KaVo DIAGNOdent) with particular attention being paid to the localization of these lesions, and lastly, sounding was carried out to detect any osseous defects and periodontal pockets.

Results. The study revealed greater incidence of demineralization and white spots in the vegan subjects compared to the omnivorous ones localized at the neck of the teeth and on the vestibular surfaces of dental elements

Received on September 24, 2009.

Accepted for publication on October 26, 2010.

Corresponding author: L. Laffranchi, Department of Biomedical Sciences and Human Oncology, University of Turin, 10100 Turin, Italy. E-mail: lauralaff@libero.it

¹Doctoral school in "Medicine and Experimental Therapy"
Department of Biomedical Sciences and Human Oncology
University of Turin, Turin, Italy
²Dental School
Department of Surgical Specialities
Radiological and Medical Forensic Sciences
University of Brescia, Brescia, Italy

(with the exception of the lower anterior group). The saliva pH, more acid in the omnivorous patients, ranged between four and six. Changes in oral conditions in both groups of subjects were observed.

Conclusion. In order to research into the cause-effect relationship of the vegan diet on the oral cavity effectively, the sample needs to be studied for a longer period of time and the results re-evaluated.

Key words: Diet, vegetarian - Food habits - Tooth demineralization.

Eating habits in developed countries have changed in recent years. Various foodstuffs have been introduced into the diet that previously did not form part of nutritional choices.

This has resulted in an enrichment of the daily diet, with the opportunity to vary foodstuffs more often and moreover this has led to the assumption, at least apparently, of a wider spectrum of nutrients required for the well-being of the body.¹

This phenomenon of massification and industrialization of nutrition with the resulting ethical involvement has brought about diversification in the various types of foodstuffs and to a paradoxical effect in many people who would like this to be nutritious and at the same time want to respect the environment and be coherent with ethical aspects of food science and technology.

Therefore, this study examined a sample possessing the common criterion of dietary habits.

The vegan diet is a very restrictive dietary regime in which the only foodstuffs assumed are those of non animal derivation.²⁻⁵ Meat and fish are excluded as are eggs, cheese, and other dairy products. This seems to contradict all the normal recommendations for nutrition in the literature and the need for a full and varied diet. Nevertheless, any long-term systemic effects of a rigid and selective nutritional regime such as this are rather controversial and fairly unclear.

Little is known of the long-term effects on the oral cavity of assuming only foodstuffs of non animal derivation so this study aimed to investigate the oral implications of a vegan diet using the method of observation.⁴ Among these effects it is hypothesised that the saliva pH will decrease in correlation with assumption of acid foodstuffs and the lack of foodstuffs in the diet such as meat and dairy products to balance this decrease in pH. Following acidification of oral pH, any demineralization or white spots resulting from this imbalance needs to be investigated.³

Both diagnosis of any oral alterations and cure or even better prevention of the same would be useful, and can act as a guide whenever they are found for the first time in patients who follow a vegan diet. Furthermore, the group in the study presented a great deal of interest in participating and in facilitating observation of how good their own health is. There was good cooperation and spontaneous participation in the sampling even though instruments and inspections were repeatedly used and carried out.

Materials and methods

Choice of sample

The sample observed in this study was composed of 15 subjects (11 men and 4 women), all of whom lived in northern Italy and were aged 24 to 60 years old. All of the subjects were healthy, none of them took pharmaceutical drugs for systematic pathologies and anamneses, and no-one in the sample suffered from allergies. To be included in the study subjects had to have followed a vegan dietary regime for at least 18 months and a maximum of 20 years, and be non-smokers. All possible factors that influence the analysis needed to be kept to a minimum. Consequently, the sample came from the same geographical origin so that variables resulting from local regional diets were minimised (fluorinated water, dietary habits, quality of foodstuffs...).⁶⁻¹¹

Among the factors affecting the choice of sample were good oral hygiene conditions that were comparable between all the subjects, and that no unhealthy oral habits were demonstrated.

Furthermore, each subject answered a questionnaire on dietary habits and oral hygiene, with particular attention to any painful symptomatology, or manifestations of oral lesions or changes noticed (Figure 1).

The measurement of the state of oral hygiene was measured whereas the Index DMFT (Decayed teeth, missing fillings and tooth decay), according to the recommendations of the World Health.

Then we performed the periodontal clinical examination noting the following: plaque index (PLI), gingival index (GI) according to Loe & Silness J. The teeth were not brushed prior to the examination. No air was used to dry the teeth. The teeth were examined from the upper right quadrant to the lower right counterclockwise.¹²⁻¹⁷

The measurement of the state of oral hygiene by Silness-Löe plaque index is based on recording both soft debris and mineralized deposits on the following teeth: 16 12 24 36 32 44. Each of the four surfaces of the teeth (buccal, lingual, mesial and distal) is given a

- Initials and surname.....
- Sex...
- Age...
- Height and weightcm.....Kg
- How many times a day do you clean your teeth?
- How long have you followed a vegan diet?
- Number of meals a day.....
- What constitutes a normal meal?
- Do you have any allergies/intolerance to foodstuffs? if so, what type?
- Does assumption of certain foodstuffs (e.g. strawberries, nuts, peaches...) cause burning sensations or irritation in the mouth? Which foodstuffs?
- Have you lost body weight since you became a vegan?
- if so, has this weight loss been significant?
- Do you follow a pharmacological therapy for a chronic condition (e.g. steroids for asthma? Cortisone? The contraceptive pill? Thyroid hormones, antidepressants, or tranquillisers?) or have you assumed them for prolonged periods?
- what type of therapy?
- Do you smoke?
- how many cigarettes a day do you smoke?
- Do you drink alcoholic beverages?
- regularly, every day
- Occasionally, if there is the opportunity
- Almost never
- Do you drink fizzy drinks or those with a high concentration of sugar?
- Yes, often
- Yes, sometimes
- No, almost never
- When did you last go to the dentist?
- Have you undergone dental treatment in the last three years?
- Do you remember what it was for?
- Has your dentist ever told you that you have demineralisation of your teeth?
- If yes, have you undergone any therapy for this? (Toothpaste, mouthwashes, fluoride gel?...)
- Do you have sensations of a dry mouth/jaws when you wake up in the morning?
- Is this sensation due to a particular type of food/types of food? If yes, which?.....
- Is this sensation:
- occasional
- frequent
- only connected to poor digestion
- negligible
- Since you became a vegan and started following a vegan diet, have you noticed any lesions in your mouth (aphthae/small ulcers)?
- if yes:
- frequently (more than once a month)
- occasionally (once/twice a year)
- Could it be correlated with the assumption of certain types of food?.....Which?
- Have you suffered candida infection in the oral cavity?
- how many times in the last three years?
- Do you have irritation/burning in the gingiva (gums)?
- when you brush your teeth, have you noticed any bleeding from the gingiva ?
- Do you experience pain when you clean your teeth?
- When you drink hot drinks, do you feel pain/irritation in your teeth?
- Yes, pain
- Yes, irritation
- No, never
- When you drink cold drinks, do you feel pain/irritation in your teeth?
- Yes, pain
- Yes, irritation
- No, never

Figure 1.—Questionnaire answered by the sample before the visit

score from 0-3. The scores from the four areas of the tooth are added and divided by four in order to give the plaque index for the tooth with the following scores and criteria:

- 0: No plaque
- 1: A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen in situ only

after application of disclosing solution or by using the probe on the tooth surface.

2: Moderate accumulation of soft deposits within the gingival pocket, or the tooth and gingival margin which can be seen with the naked eye.

3: Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin

The gingival index is scored as follows: 0 = normal gingiva, no inflammation discoloration or bleeding; 1 = mild inflammation, slight colour change, mild alteration of gingival surface, no bleeding on pressure; 2 = moderate inflammation, erythema and swelling, bleeding on pressure; 3 = severe inflammation, erythema and swelling, tendency to spontaneous bleeding, perhaps ulceration. The plaque index is scored as follows: 0 = no plaque; 1 = tooth appears clean but plaque may be removed from its gingival third with a probe; 2 = moderate accumulation of plaque deposits visible to the naked eye; 3 = heavy accumulation of soft material filling the niche between the gingival margin and tooth surface.

A control group of 15 subjects therefore had similar criteria of age and place of origin to the study group but followed a varied dietary regime including the consumption of meat and products of animal derivation.

The control group followed the same sample analysis procedure as the study group. The subjects answered the questionnaire and were then visited according to the criteria of the study.

Statistical analysis

The sample available, including the study and the control groups, was evaluated from both a purely anamnestic point of view and also from the clinical point of view by objective examination. Subject to informed consent, aspects of more specific interest and correlated more closely with observance of specific dietary habits were focussed on during the visit.

The investigation concentrated on the following criteria:

a) saliva pH for both the study group and

the control group measured at the same time of the morning

b) Demineralization and lesions not immediately visible

c) Visible precarious lesions / white spots localisation of the lesions in determined areas

d) Calculation of the DMF score

e) Plaque Index

f) Gingival Index

The saliva pH evaluations were carried out using appropriate litmus paper while a diagnostic instrument (KaVo DIAGNOdent) was used to find white spots as it was able to provide numerical data as well as gauge the hardness of the dental tissue, in addition to the opportunity to use light to show the true extent of demineralization not visible to the naked eye. Thanks to this instrument class I lesions or sulcal lesions were diagnosed.⁶⁻¹³

To analyze the continuous variables (pH, DMFT, plaque index and Gingival Index) we applied the nonparametric test of Wilcoxon rank-sum, for the dichotomous variables (presence / absence of visible lesions and white spots), we used the Fisher's exact test setting the significance at 0.05.

Results

The results obtained were uniform throughout the study sample. Each criteria was individually analysed (from point a to point f) in order to be able to evaluate the oral situation of the subjects in a more general way.

The control group was evaluated for each point so that the results for the two groups could be compared (Table I).

Study group

a) Saliva pH: Between 5 and 6 in all subjects analyzed;

b) demineralization and lesions not immediately visible: areas of demineralization not visible to the naked eye were verified in all the sample by using infrared light. Their size varied between 2 and 3 mm and they were generally oblong in shape;

c) visible precarious lesions / white spots:

TABLE I. — *Results of the objective examination of the two groups.*

Criteria	Study group	Control group
Saliva pH	5-6	7-8
Non visible lesions	Always present	Found Occasionally
White spots	Always present	Found Occasionally
Localisation	Vestibular and cervical areas	Interproximal areas
DMFF	9.8	9
Sounding	Absent	Present in one case

white spots were found in all of the sample, oblong lesions between 2 and 6 mm in size;

d) localization of lesions in specific areas: the lesions with demineralization, both those visible and those non visible, were mainly localized in vestibular or even cervical vestibular sites (class V). With the exception of the lower anterior area, all of the surfaces of the other dental elements were generally affected, especially the upper and lower molars and premolars;

e) calculation of the DMF: The quantity of missing teeth and teeth with fillings was not investigated or significant. When compared to the control group, the amount of conservative restorations was not found to be a particularly indicative element. The DMF was 9.8;

f) plaque Index: Average value was 1.33;
g) gingival Index: Average value was 0.85.

Control group

a) Saliva pH: The pH of the omnivorous subjects ranged from 7 to 8;

b) demineralization and lesions not immediately visible: The observation of areas of demineralization were not significant as they were only occasionally found during the objective examination;

c) visible precarious lesions/white spots: precarious lesions of whitish appearance were found in the posterior areas of only 2 of the 15 subjects;

d) localization of the lesions in specific areas: the lesions found in two subjects presented in the interproximal areas of the molars and in contrast to the study group were not diffuse;

e) calculation of the DMF: the amount of

conservative restorations or edentulism was similar in both groups. In fact, the control group had a Dmf of 9;

f) plaque Index: Average value was 1.33;
g) gingival Index: Average value was 0.78.

Discussion

The tests applied to analyze pH, DMFT were statistically highly significant with $P < 0.001$. Test on plaque index ($P = 0.78$) and gingival index ($P = 0.35$) reported to be no significant differences between the two groups, as oral hygiene habits were similar between the two groups. The tests used for the analysis of the presence of visible lesions were highly significant ($P < 0.001$) indicating that they were present in 100% of cases in the study group and 13% in the control group. Tests for the study the White Spot were highly significant ($P < 0.001$) indicating the presence of white spots in 100% of subjects in the study group and in 20% of subjects in the control group.

The location of the lesions was investigated by analyzing observational data. The result is that the localization of lesions in the study group was distributed evenly to the buccal surfaces of premolars and molars. In the control group these findings were incidental and, where lesions appeared, they were mainly in the interproximal areas, probably due to an improper use of dental floss or dexterity in oral hygiene.

Conclusions

Analysis of the results reveals major oral changes in those who follow a vegan diet

compared to those with a varied diet. This would seem to suggest interdependence, or at least a relationship, between the assumption of this type of diet and oral changes such as lowering of the pH and the onset of demineralization. However, to investigate the existence of the cause-effect relationship effectively, the sample will be subject to the visit and the questionnaire again in 12 months, and surveillance will take place for a prolonged period of time so that the results can be re-analyzed.

We are not able to compare the results with works in literature because the only ones among those who analyze the effects of diets on the stomatognathic apparatus come from specific areas of the world where dietary habits are different from those in Europe (east Asia) and relate mostly to the vegetarian and not vegan diet

References

1. Al-Dlaigan YH, Shaw L, Smith AJ. Vegetarian children and dental erosion. *Int J Paediatr Dent* 2001;11:184-92
2. Linkosalo E. Lactovegetarian diet and dental health. *Proc Finn Dent Soc* 1988;84 Suppl 8-9:1-77.
3. Linkosalo E, Syrjanen S, Alakujala P. Salivary composition and dental erosions in lacto-ovo-vegetarians. *Proc Finn Dent Soc* 1988;84:253-60.
4. Linkosalo E, Markkanen H. Dental erosions in relation to lactovegetarian diet. *Scand J Dent Res* 1985;93:436-41.
5. Geddes DA, Edgar WM, Jenkins GN, Rugg-Gunn AJ. Apples, salted pea nuts and plaque pH. *Br Dent J* 1977;142:317-9.
6. Imfeid TH. Apples, salted peanuts and plaque pH. A telemetric in vivo re-examination. *Br Dent J* 1978;145:303-5.
7. Eccles JD, Jenkins WG. Dental erosion and diet. *J Dent* 1974;2:153-9.
8. Aliano MC. Controversies, perspectives and clinical implications of nutrition in periodontal disease. *Dent Clin N Am* 1976;20:519-40.
9. Linkosalo E, Markkanen H, Syrjanen S. Effects of a lacto-ovo-vegetarian diet on the free amino acid composition of wax-stimulated whole human saliva. *J Nutr* 1985;115:588-92.
10. Krey SH. Alternate dietary lifestyles. *Prim Care* 1982;9:595-603.
11. Tiegen VE, Sintes JL, Dwyer JT. A model for evaluating cariogenicity applied to vegetarian diets. *ASDC. J Dent Child* 1981;48:278-84.
12. Herre CW, Herwig RV. Vegetarian vs. normal as casual agents in tooth decay. *J Kans State Dent Assoc* 1977;61:12-4.
13. Rahmatulla M, Guile EE. Relationship between dental caries and vegetarian and non-vegetarian diets. *Community Dent Oral Epidemiol* 1990;18:277-8.
14. Chaves ES, Wood RC, Jones AA, Newbold DA, Maxwell MA, Kornman KS. *J Clin Periodontol* 1993;20:139-43.
15. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. *Int Dent J* 1975;25:229-35
16. Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. *Acta Odontol Scand* 1963;21:533-51.
17. Silness J, Loe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand* 1964;22:121-35.