

THE EFFECT OF SUGAR-FREE GREEN TEA CHEW CANDIES ON THE DEGREE OF INFLAMMATION OF THE GINGIVA

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Abstract: The components of green tea extracts such as catechins and polyphenols gain increasing significance in tumor research and immunology.

The clinical double blind study presented here was aimed at the investigation on how green tea catechins and polyphenols in the form of green tea dragées may influence the inflammatory behaviour of the gingiva. A total of 47 test persons with a mean age of 25.76 years (23 males, 24 females) were randomly divided into two groups: one group (n = 22: 11 males, 11 females) received chew candies containing green tea extracts, the other group (n = 25: 12 males, 13 females) received placebos with the same flavour but without active substances. At the beginning of the four week investigation period, a professional dental cleaning was carried out on all test persons. Then the persons were instructed to do their usual dental cleaning and chew eight candies distributed over the day. The API (approximal plaque index) and the SBI (sulcus bleeding index) were determined after seven days (API-1, SBI-1) and after another 21 days (API-2, SBI-2). Within the verum group, a mean value of $33.2\% \pm 18.3\%$ was determined for API-1, and $29.6\% \pm 17.5\%$ for API-2. The mean SBI-1 was $5.9\% \pm 7.6\%$, and $3.6\% \pm 5.8\%$ for SBI-2. The clinical data within the placebo group were different: The plaque index values changed from API-1 $30.3\% \pm 16.3\%$ after one week to API-2 $31.8\% \pm 17.2\%$ after another three weeks. The values for the inflammatory degree of the gingiva had also changed to the negative: from SBI-1 $3.4\% \pm 4.1\%$ after seven days to SBI-2 $4.7\% \pm 6.4\%$ after another 21 days. Whereas in the verum group a distinct improvement in both API and SBI values could be stated, slight worsening of the values were determined for the placebo group. The results indicate that the oral application of green tea catechins and polyphenols might have a positive influence on the inflammatory reaction of periodontal structures.

Key words: green tea; catechins; gingival inflammation

INTRODUCTION

In the last two decades, the consumption of green tea products and their popularity in the Western part of the hemisphere rapidly increased while these products are an important part of the basic diet in the whole Asian-Pacific area for more than four thousand years.

Several thousand years ago, the tea plant *Camellia sinensis* was originally discovered and cultivated in South-East Asia, and said to arrive at China about 2700 BC at the time of the emperor Shen Nung (Harbowy et al. 1997). Since these days, green tea worldwide enjoys an enormously high per capita consumption which is almost comparable with that of water. In the Federal Republic of Germany, the total consumption of green tea increased - in 1998 alone - from 1685 t to 4870 t compared to the previous year (Deutscher Teeverband e.V.).

Today almost thirty countries cultivate tea and apply value adding methods (Ahmad et al. 1998, Katiyar et al. 1996).

Green and black tea as well as the semi-fermented Oolong tea are different kinds of tea which originate from the same plant of *Camellia sinensis* but are essentially different in their processing. For green tea the tea leaves are picked, rolled. The intra-cellular enzymes are inactivated immediately after harvesting by gentle heat treatment.

This is different for the fully-fermented black tea and the semi-fermented Oolong tea where the enzymes are allowed to act in full during the wilting process. Depending on the wilting time, the fermentation may take up between 5% and 100% of the whole processing time. The fermentation process was developed in the 18th and 19th century to preserve the tea especially for the long transport from Asia to Europe. Before this time, only the processing of green tea was known in Asia as well as in Europe. In the medical field the increasing number of scientific studies on green tea underlines the importance of the effects associated with green tea components in plant pharmacolo-

gy. In numerous fields of general medicine as well as in dentistry, the effect of green tea and its components on healthy and sick organisms has been investigated *in vivo* and *in vitro*, as described in the following.

First of all, the studies in the field of tumor prevention and therapy regarding the effect of green tea polyphenols on tumor growth, e.g. with lung (Sazuka et al. 1997), prostate (Gupta et al. 2000) and squamous cell carcinomas (Li et al. 1999, Yang et al. 1999) and on precancerous stages in the oral cavity (Khafif et al. 1998) have to be mentioned here. In addition, a protective influence of green tea polyphenols against cardiovascular diseases is discussed (Tijburg et al. 1997).

In dentistry, especially the influence of green tea components on plaque development and the possible reduction of caries formation as well as a curative effect on the inflammatory gingiva and the affected periodontium is of interest for the field of prevention.

Besides the proven effect of the high fluoride content in green tea on the enamel hardening and the support of remineralisation respectively, recent findings on the influence of polyphenols on the metabolic process, the possible adhesion of the bacteria as well as on the influence on the metabolism of some bacteria present in the oral flora are gaining importance (Yu et al. 1992, Rasheed et al. 1998, Horiba et al. 1991, Tagashira et al. 1997, Sakanaka et al. 1996).

In the field of periodontology, the influence of the radicals released by leucocytes with deficient respectively lacking antioxidative response on the organism in the case of chronic adult periodontal disease is discussed (Guarnieri et al. 1991, Chapple et al. 1997). These studies can open a new field for green tea research activities as the antioxidative effect of the polyphenols has already been investigated to a large extent (Benzie et al. 1999).

For the occurrence of destructive periodontal diseases, it is also known that the decomposition of collagenous fibres caused by bacterial collagenase is a decisive pathogenic process (Larivee et al. 1986, Golub et al. 1979, Golub et al. 1976). Numerous studies prove that above all the treatment of some forms of periodontal diseases with antibiotics from the tetracycline group, which inhibit the production of certain bacterial collagenases, was successful (Genco 1981, Korman et al. 1982, Makimura et al. 1993). In this context, it was found that green tea polyphenols inhibit not only the collagenase activity in the lung carcinoma cells (Sazuka et al. 1997) but also the activity of *Porphyromonas gingivalis* (Golub et al. 1983), a pathogenic periodontal bacterium.

In the present clinical study, the possible influence of chew candies containing green tea extract on the metabolic behaviour of the oral plaque and the inflammatory process of periodontal structures were examined on a group of young patients showing a good general condition.

MATERIAL AND METHODS

The stimulating effect of caffeine is one of the qualities of green tea for which it is known and valued for a long time. Although tea does not have any physiological nutritional value it contains, however, components which are important from the medical point of view. The green tea polyphenols, and here in particular the catechins and their effect on the whole organism, have gained more and more importance in the last years as will be explained in the following.

The catechins can be divided into six groups: (+)-Catechin (C), (-)-Epicatechin (EC), (+)-Gallocatechin (GC), (-)-Epigallocatechin (EGC), (-)-Epigallocatechin gallate (ECg) und (-)- Epigallocatechin gallate (EGCg) (Sakanaka et al.1989).

Table 1. Components of green tea in percent of the dry substance according to Balentine et al.1997; Herrmann 1983.

Components of the green tea leaf extract	Parts of the components in the green tea infusion (in%)
Catechin	30-42
Theaflavins	0
Flavonols	2
Other Polyphenols	6
Caffeine	3-6
Theanin/Amino acids	Je 3
Peptides/Proteins	6
Carbohydrates	11
Potassium	5
Other mineral substances	5-8

Table 2. Division of the components of green tea gums in weight-percent.

Components	Placebo	Verum
Sorbit-dry substance	25.2	24.9
Maltitol syrup-dry substance	25.6	25.3
Gum arabicum	35.2	34.7
Water	13.01	13.1
Dye-dry substance	0.21	—
Plant extract, green	0.13	0.13
Tea-Aroma	0.39	0.32
Bitter-Aroma	0.26	—
Tea-extract	—	1.55

PATIENTS

For the clinical double blind study 47 volunteers (students of the Johannes Gutenberg University of Mainz) were selected, 23 males and 24 females with a mean age of 25.76 years. Persons with

systemic, metabolic or profound periodontal diseases, with pregnancy, rheumatic complaints, permanent medication, less than 20 teeth and chain smokers (more than 15 cigarettes per day) were excluded. The participants were divided into two groups, one group ($n = 22$: 11 males, 11 females) received chew candies with green tea extract, the other group ($n = 25$: 12 males, 13 females) received placebos with the same flavour but without active substance. The mean age of the verum group was 26.05 ± 4.19 years, that of the placebo group 25.48 ± 2.77 years.

The average weight of a chew candy was 1.1 g.

METHOD OF DENTAL EXAMINATION

At the beginning of the study, which lasted four weeks, a thorough dental examination including the evaluation of the periodontal situation and a professional dental cleaning was carried out with each person. All persons were instructed to continue their regular dental care with the dental brush and tooth paste they normally used. In addition, they were instructed to chew eight candies distributed over the day (chewing time per candy about five minutes, total daily chewing time about 40 minutes, interval without chewing 1 hour each). After seven days and again after another 21 days the bacterial plaque accumulation was determined using the Approximal Plaque Index (API-1 after one week, API-2 after another three weeks). The inflammatory degree of the gingiva was determined using the Sulcus Bleeding Index (SBI-1 after seven days, SBI-2 after another 21 days). Furthermore, an examination of the oral mucosa was done in further examinations. In addition, the test persons were asked about their subjective estimation regarding the possible positive influence of the chew candy on the oral mucosa. They could give details about the taste of the candies and their texture or solubility respectively.

RESULTS

VERUM GROUP

After the first week of the study, the test persons from the verum group ($n = 22$: 11 males, 11 females) showed a mean value of the approximal plaque index (API) of $33.2\% \pm 18.3\%$. After three more weeks the participants showed a slight reduction to $29.6\% \pm 17.5\%$. The mean values of the sulcus bleeding index (SBI) were at $5.9\% \pm 7.6\%$ or $3.6\% \pm 5.8\%$ respectively.

PLACEBO GROUP

After four weeks, the mean value of the approximal plaque index (API) of the placebo group slightly increased from $30.3\% \pm 16.3\%$ to $31.8\% \pm 17.2\%$. After four weeks, the mean value of the sulcus bleeding index (SBI) also increased from $3.4\% \pm 4.1\%$ to $4.7\% \pm 6.4\%$.

EVALUATION OF THE MEDICAL DATA

For the verum group the data generally improved even if the results were not significant. These slight differences may result from the fact that all test persons exhibited a good oral hygiene as they were dental students.

The interviews on subjective data showed that all test persons liked the taste of the candies and that the texture was experienced as being of a pleasant hardness and a tolerable adhesiveness. The examination of the oral mucosa did not show any pathological results.

Table 3. Results of the probands' indices.

	Verum-group (n = 22)	Placebo-group (n = 25)
Age	26.0 + 4.2	25.5 + 2.8
API 1	33.2% + 18.3%	30.3% + 16.3%
API 2	29.6% + 17.5%	31.8% + 17.2%
SBI 1	5.9% + 7.6%	3.4% + 4.1%
SBI 2	3.6% + 5.8%	4.7% + 6.4%

DISCUSSION

The present study had the objective to determine to what extent green tea catechins in chew candies would influence the clinical process of gingival inflammation. For the verum group the results showed a slight decrease in gingival inflammation after four weeks based on the approximal plaque index (API) as well as on the sulcus bleeding index (SBI), while for the placebo group a slight increase in API and SBI values were stated (Fig. 1). The positive results of the verum group may be attributed to the proven inhibitory action of green tea polyphenols on the cellular adhesiveness of *Streptococcus mutans* and also *Porphyromonas gingivalis*. Tagashira et al. (1997) and Sakanak et al. (1996) found earlier that the presence of green tea polyphenols inhibits the cellular adherence to the buccal mucous membrane and the growth of *Porphyromonas gingivalis*, especially due to (-)-Epigallocatechingallate (Sakanaka et al.). The so-called Hop-bract polyphenols from green tea and Oolong tea extract with high molecular weight display an inhibitory influence on the cellular adherence and the glucane synthesis of *Streptococcus mutans* (Tagashira et al.). It could not be verified in the present study that gum arabic used as candy base had an inhibitory effect on the formation and accumulation of plaque (Gazi 1991), as the placebo group showed a slight increase of the SBI value, although the placebo contained gum arabic as well. It could also not be proven - as the presented results showed - that the chewing of sorbitol containing candies may result in a reduced plaque accumulation (Hoermann et al.

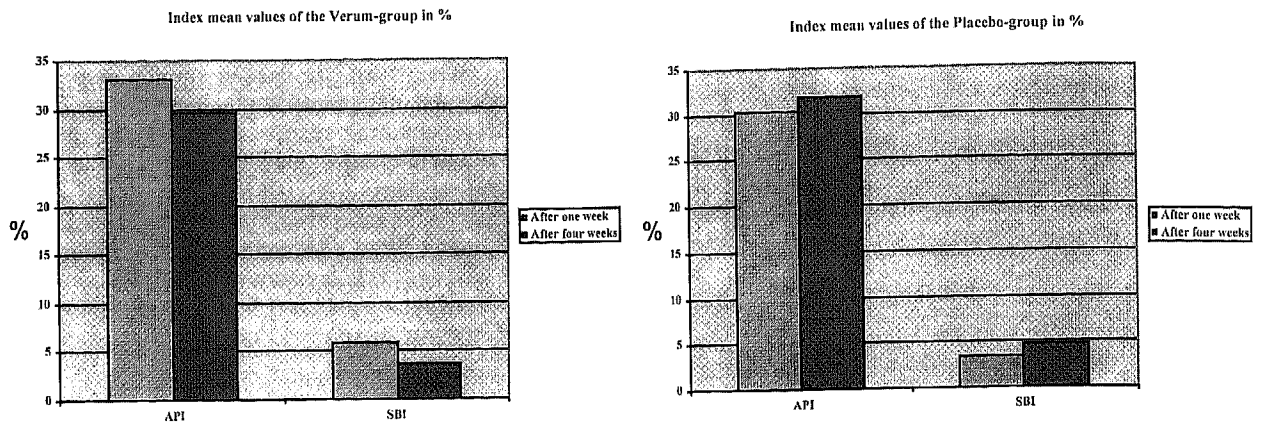


Fig. 1. Structural formula of the green tea catechins.

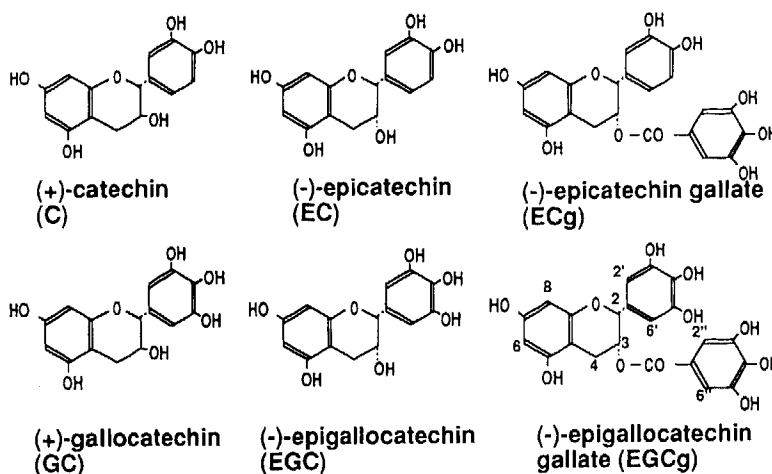


Fig.1. Mean index values of the Verum- and Placebo-group in percent.

1990) as sorbitol was part of the candies given to the verum as well as to the placebo group, because only the values of the placebo group, showed an increase in the approximate plaque index (API).

The Hawthorne effect (Jeffcoat 1992), describing a push in motivation mainly at the beginning of the study at all participants, could have a positive impact on the stated result. This is, however, contradicted by the bad API and SBI values of the placebo group, because the pretreatment was the same for both groups and none of the participants nor the investigators of this double blind study knew whether they were taking or handing out the green tea containing chew candy or the placebo type.

In the present clinical study on the influence of chew candies containing green tea extract on the clinical process of gingival inflammations, it could be demonstrated that there is a possible positive influence of the polyphenols on the reduction of the inflammatory inclination of the gingiva as well as on the inhibition of plaque accumulation. The API and SBI values of the verum group showed the tendency of improvement whereas the values of the placebo group aggravated slightly. This study also confirms the results of other studies on the effect of green tea polyphenols re-

garding the plaque formation behaviour and the influence on pathogenic bacteria in the oral flora.

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