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## **Biotin (Vitamin H) – An active ingredient for improving the quality of hair keratin**

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### **Introduction:**

Biotin is of vital importance for the proliferation and the differentiation process of cells in general. It is coenzyme for carboxylases reactions and is obviously responsible for further metabolic steps, which are not yet understood completely [2]. Biotin is of extreme importance for tissues exhibiting high metabolic activity/turnover [1,6]. The advised daily (**internal**) uptake was estimated in 1989 by the „Deutsche Gesellschaft für Ernährung (DGE)“ and the „Recommended Dietary Allowances (RDA)“ to amount to 30 – 100 microgram for adults. The amount of Biotin being excreted daily is considerable higher than the uptake through the diet. This finding has led to the assumption that a lack of Biotin can be excluded. It could be shown in horses, that Biotin being formed in the environment of the colon cannot be resorbed because of a lack of an appropriate system for resorption; consequently, the Biotin, which has been produced in the colon is not bioavailable and is excreted quantitatively. The situation in humans seems to be similar to horses [1]. A lack of Biotin for different reasons disturbs various skin functions and leads to reduced hair growth and loss of hair. [1]. It could be shown that biotin supplements for people with brittle fingernails improved the quality of fingernails considerably within 6 months [1, 3 – 5].

Older investigations showed similar effects of Biotin on humans with thin and fragile hair, enhancing the quality of newly formed keratin structures[7]. These findings indicate a higher demand for Biotin in tissues, which keratinize, than in those, which do not; the enhanced need for Biotin is obviously not covered sufficiently by the diet.

To determine possible effects of Biotin on the structure of hair (applied epicutaneously on the scalp) a double blind study has been carried out on healthy men (18 – 60 years old) with thin and very thin, fragile hair (diameter less than 60 microns). The pilot study was done as a „before-after“ study on 60 individuals, some of them with normal hair. Two different concentrations of Biotin have been tested, namely 0.003 % and 0.01 %. Following this preliminary investigations a second experiment was carried out on 120 individuals in a „placebo-verum“ study; one single concentration of Biotin was tested – 0.1 %. The experimental part of this study will be completed in spring 96.

## Results:

Study 1 is finished and has been analysed. The experimental part of study 2 with 6 weeks of preparation time and 12 months treatment, will be finished in the course of this year; the evaluation now covers the first 3 months of treatment. As expected, the data of this part of the study (**study 2**) does not show any changes in the quality of hair. For this reason we are discussing in the following the data of study 1 more deeply. Both concentrations used showed almost similar efficacy of Biotin on the tensile strength of the hair. Since one could find already significant biological activity in case of the lower concentration (**0.003 %**), both treated groups have been evaluated together. **Figure 2** and **Figure 3** represent weight and number of lost hair, which has been collected by the panellists; this parameter usually shows big variations over the time. After a significant reduction of number and weight of lost hair during the preparation period, the values seem to stabilise around 100 hairs per day. Table 1 and table 2 show the changes in the tensile strength of hair over the time. This has been measured during the test period according to scheme 1 (**key to scheme 1 and 2 at the end of the translation**). Values of all test individuals and average values are given in **table 1**. Highly significant effects have been found at the end of the test period (**31<sup>st</sup> week**). **Table 2** and **Figure 4** prove significant results for individuals with fine and very fine hair already after 12 weeks of treatment. Subjective assessments of hair quality by trained hairdressers revealed a decrease of splitted hair as well as reduction of „flying hair“. These findings complete the results about changes of objective parameters in a meaningful manner.

## Methods:

Healthy men with minimal male hair loss were put into the different study groups by randomised selection. They were advised to use exclusively the hair treatments, which have been determined in the test protocol. In study 1, 28 % of panellists had normal hair, 48 % had thin hair and 24 % had very thin hair. 9 individuals had to stop the testing for various reasons, in none of the cases for health reasons. The testing panel of study 2 was composed exclusively of individuals with thin and very thin hair. During the first 6 months none of them had to cease the study. **Schemes 1 and 2** give an overview about the test protocols. Treatment with Biotin was started in study 1 after a control phase of 6 weeks and carried out until the finalisation of the study. Panellists of study 2 were treated with a Biotin lotion or placebo during the entire testing period. In both studies the lotion was applied to the dry scalp once daily and gently rubbed into the skin. 30 panellists of study 1 were treated with lotion containing 0.003 % Biotin, 30 panellists were treated with a lotion on 0.01 % Biotin. Concentrations were calculated on the basis of the normal daily dose considering penetration rates, so that with the lower concentration (**0.003 %**) a normal daily dose was delivered to living tissue. Applied volumes per treatment were 5 ml. Treatments were carried out by the panellists at home. At the start of the study and during the study the hair was cut regularly to 6 – 8 centimetres by experienced hairdressers. Panellists had to comb the hair twice daily, to count them and to deliver the weekly amount in bags to the testing institute. Random sample surveys by the institute's personnel showed, that the panellists counted the hair accurately. The weight of the hair was determined by the institute after drying it for 24 hours at 60 °C. Various

subjective parameters, i.e. splitted hair, „flying hair“, were assessed by experienced hairdressers during the test period. The tensile strength was determined with samples taken from the light-protected area 3 cm above the ears. This is the area of typical male hair loss (**see figure 5**). The hair samples were mixed. 20 hairs were taken from the mixed sample and measured. In study 2 the trichogram's time course was determined to check possible changes in the hair growth cycle. All panellists received a standard shampoo, which could be applied *ad libitum*, following a standard washing protocol. Statistical evaluation of study 1 was done using the t-test, study 2 was evaluated following Shapiro-Wilk-test.

### **Discussion:**

Our results confirm visual findings [7] on the basis of quantitative data. We find after 6 months of epicutaneous treatment with a Biotin lotion an improvement of various quality parameters especially on panellists with thin and very thin, brittle hair. The changes are low in percentage, but highly significant. Since both concentrations (0.003 and 0.01 %) showed similar effects, we assume that the lower concentration exhibits already a sufficient effect. Number and weight of lost hair show a very distinct course. During the control period a large number of the loose shaft hair and the anagen hair (prepared for breaking) was lost due to the intensive and frequent combing.

Further with the treatment the epithelia around the hair bulb was strengthened by the Biotin supplement and become a stronger basis for the shaft hair. The anagen hair had a more solid structure after the Biotin treatment, which resulted in a lower breakage rate. This finding is supported by an increasing tensile strength (approx. 6 %). The relatively small changes have visible consequences on the subjective parameters of hair quality. It is still an open question, whether the diameter of the hair shaft is increasing or whether the structure of hair with a constant diameter is strengthened. We will also investigate this problem. We expect after a Biotin treatment period longer than 6 months a similar finding as in the case of fingernails and a further manifestation of effects.

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## Key to tables and schemes

### Table 1: Tensile strength (in gram)

(top row) Panellist, 3<sup>rd</sup> week, 7<sup>th</sup> week, 19<sup>th</sup> week 31<sup>st</sup> week, difference 7<sup>th</sup>/3<sup>rd</sup> week, difference 19<sup>th</sup>/3<sup>rd</sup> week, difference 31/3<sup>rd</sup> week

### Table 2: Tensile strength of thin/fine hair (in gram)

(top row) Panellist, 3<sup>rd</sup> week, 7<sup>th</sup> week, 19<sup>th</sup> week 31<sup>st</sup> week, difference 7<sup>th</sup>/3<sup>rd</sup> week, difference 19<sup>th</sup>/3<sup>rd</sup> week, difference 31/3<sup>rd</sup> week

(down left) Number, average, standard deviation, ???? (cannot be read, even in the original journal), FG, t-value, p

### Figure 4: Tensile strength of normal and fine hair

#### Scheme 1

(top row) schedule/weeks, application, hair cut, assessment by hairdresser, hair count/weighing, measuring tensile strength, control term, hair wash

(second column, top) control period  
 (second column, down) treatment period  
 (fifth column) continuously  
 (eighth column) as usual

#### Scheme 2

(top row) schedule/weeks, application, hair cut, assessment by hairdresser, hair count/weighing, measuring tensile strength, control term, hair wash

(second column, top) control period  
 (second column, down) treatment period  
 (fifth column) continuously  
 (eighth column) as usual