

- aus dem Englischen -

Ein Dermonährstoff mit speziellen Kollagen-Peptiden verbessert die Hautstruktur und -funktion: eine randomisierte, placebokontrollierte, dreifach verblindete Studie zu kosmetischen Effekten und Verträglichkeit eines Trink-Kollagens, untersucht mit konfokaler Laser-Scanning-Mikroskopie

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Zusammenfassung (aus dem Englischen):

Ziel dieser randomisierten, placebokontrollierten, dreifach verblindeten Studie mit 60 hautgesunden Probandinnen war es, kosmetische Effekte eines Nahrungsergänzungsmittels mit speziellen Kollagen-Peptiden und Acerola-Fruchtextrakt, Vitamin C, Vitamin E, Biotin und Zink (ELASTEN[®], QUIRIS Healthcare, Deutschland) nach 12-wöchiger Einnahme auf die Hautqualität zu untersuchen. Um das Verzerrungsrisiko zu minimieren und die Genauigkeit und Objektivität der Ergebnisse zu erhöhen, wurde das Studiendesign dreifach verblindet. So wussten weder die Probandinnen noch die verabreichende Person noch die Person, die die primären Ergebnisse ausgewertet hat, welche der Studienteilnehmerinnen das Testprodukt bzw. das Placebo erhalten hatten. Darüber hinaus wusste der Experte, der die Bilder der konfokalen Laser-Scanning-Mikroskopie beurteilt hat, nicht, zu welchem Zeitpunkt (Tag 1 oder 85) das jeweilige Bild aufgenommen wurde. Die objektiven, verblindeten und bewerteten Bildanalysen der konfokalen Laser-Scanning-Mikroskopie zeigten eine signifikante Verbesserung der Kollagen-Struktur der Gesichtshaut (primärer Endpunkt) nach Einnahme des Testprodukts, während keine Verbesserungen nach Einnahme des Placebos festgestellt wurden. Die nachgewiesene, positive ernährungsphysiologische Wirkung auf die Kollagen-Struktur steht in Einklang mit den subjektiven Bewertungen zur Verbesserung relevanter Hautparameter wie Elastizität, Faltenvolumen und Ebenmäßigkeit an verschiedenen Körperarealen wie Gesicht, Händen, Dekolleté, Hals, Rücken, Beinen und Bauch (sekundärer Endpunkt). Das Testprodukt erwies sich als sicher und sehr gut verträglich. Eine kosmetisch relevante Verbesserung der Gesichtshaut nach Einnahme des Kollagenpräparats wurde nachgewiesen.

A Dermonutrient Containing Special Collagen Peptides Improves Skin Structure and Function: A Randomized, Placebo-Controlled, Triple-Blind Trial Using Confocal Laser Scanning Microscopy on the Cosmetic Effects and Tolerance of a Drinkable Collagen Supplement

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ABSTRACT The purpose of this randomized, placebo-controlled, triple-blind trial on 60 healthy female volunteers was to assess the cosmetic effects on skin quality of a food supplement containing special collagen peptides together with acerola extract, vitamin C, vitamin E, biotin, and zinc after an intake of 12 weeks (Elasten[®], QUIRIS Healthcare, Germany). To reduce assessment bias maximally and increase the accuracy and objectivity of the outcomes, the trial design was triple blinded in a manner that neither the subjects nor the person administering the products nor the person who assessed the primary outcomes knew which subjects had received the test product and which had received the placebo. The expert grader assessing the confocal laser scanning microscopy images was additionally blinded regarding the time when the image was taken (on days 1 or 85). The objective, blinded, and validated image analyses using confocal laser scanning microscopy showed a significant improvement of the collagen structure of facial skin (primary endpoint) after intake of the test product, while no improvements were found after intake of the placebo. The proven positive nutritional effect on the collagen structure was fully consistent with positive subjective evaluations of relevant skin parameters such as elasticity, crinkliness/wrinkliness, and evenness in different body areas such as face, hands, décolleté, neck, backside, legs, and belly, all serving as secondary endpoints. The test product was found to be safe and very well tolerated. A cosmetically relevant improvement of the facial skin was demonstrated after administration of the collagen supplement.

KEYWORDS: • *antiaging* • *collagen peptides* • *dermal collagen structure* • *dermonutrient* • *oral collagen supplement* • *skin beauty*

INTRODUCTION

THE ENVIRONMENT as well as stress and chronological aging can induce irreversible, and also reversible, changes in the structural components of the skin that lead to visible signs of aging such as increased dryness and wrinkle formation.^{1–3} The appearance of the skin depends to a large extent on the homeostasis of the dermal extracellular matrix that is primarily defined by collagen and similar fibers.⁴ Orally administered collagen peptides and synergistically acting dermonutrients can reach the deeper layer of the skin and stimulate the endogenous production of extracellular matrix components in the skin.⁵ These oligopeptides are

derived from an enzymatic hydrolysis leading to highly bioavailable and thus bioactive short-chain collagen peptides that are able to induce beneficial cosmetic effects.⁶ The purpose of this study was to investigate the cosmetic effect of a collagen supplement on the appearance of skin in healthy women.

MATERIALS AND METHODS

Study design and ethical aspects

The study was performed using a randomized, parallel group, placebo-controlled, and double-blind design following the principles of Good Clinical Practice. The study was registered in the German Clinical Trial Register and the ICTRP (no. DRKS00017093). The investigation was in full compliance with the principles outlined in the Declaration of Helsinki and with national regulations. A written declaration of informed consent was received from all volunteers. The trial protocol was approved by the Freiburg Ethics Committee International on December 18, 2017.

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Subjective evaluation

Subjective assessments of product traits and cosmetic effectiveness on the quality of the skin were recorded on day 85 using a questionnaire. The general evaluation of product effects on the skin was covered using 15 questions/statements concerning the improvement of the following criteria: dryness, scaliness, elasticity, complexion, firmness, crinkliness, radiance, evenness, softness, healthiness and suppleness of the skin, the need for external care products, the perception of a high product effect, the perception of a strong product effect, the evaluation of skin changes noticed by people in the participants' personal environment, and the general satisfaction with the product. Furthermore, the positive product effects (less dry, fewer wrinkles/scales, more radiant/even/supple, softer, healthier, firmer) were related to one or more of the body areas (face, hands, décolleté, neck, backside, legs, belly) at the end of the study.

The tolerability and digestibility of the product, as well as the sensitivity of the skin, were also assessed at the end of the study. Adverse events or severe adverse events and changes in concomitant therapy, as well as compliance checks, had to be documented on days 29, 57, and 85.

Blinding

The triple-blinded procedure was chosen to maximally reduce assessment bias and to increase the accuracy and objectivity of the outcomes. The trial design was triple-blinded in a manner that neither the subject nor the person administering the products nor the person who assessed the primary outcomes knew which subjects had received the test product and which had received a placebo. The expert grader of the confocal laser scanning microscopy images was additionally blinded regarding the time when the image was taken (on days 1 or 85).

Statistical analyses

Safety and tolerance data listing was based on the safety population (intention to treat population), which included all trial participants who were enrolled into the study and who received at least the first dose of the study intervention. The efficacy analysis was based on the per-protocol population, including all subjects randomized in the study in accordance with both the inclusion and exclusion criteria and who finished the study according to the protocol without any major protocol violations and who had not withdrawn their consent.

The primary endpoint of the study was defined as the change in the collagen structure. The mean value of at least three image gradings per subject was used as raw data for further statistical analyses and comparison of placebo and verum. For the descriptive data analysis of the collagen structure, number of individuals (N), means, standard deviations, and 95% confidence intervals (CI) of all subjects were calculated. Bar charts with mean values and 95% CIs were created to compare the placebo and verum interventions. For the primary analysis, a *t*-test for independent samples with a significance level of $\alpha=0.05$ was conducted on the raw data.

The secondary endpoint was the trial participants' subjective assessment of product effects on the quality of the skin by the subjects enrolled in this controlled study. Within the context of a descriptive data analysis, a significance level of 0.05 (α) was chosen for statistical analysis. Counts, percentages, and means of scores were provided for all parameters of the questionnaire. For the parameter collagen structure, pairwise comparisons of postintervention assessment and baseline were performed on the raw data for each intervention separately with paired *t*-tests versus the benchmark of 0 (no differences between assessment times). The parameters of the subjective assessments serving as the secondary endpoint were analyzed using the Mann–Whitney–Wilcoxon test for pairwise comparison of the study groups.

Statistical analyses were performed according to the principles of the ICH guideline E9 “Statistical Principles for Clinical Trials” using the SAS software, version 9.4 for Windows, SAS Institute, Inc., Cary, NC, USA.

RESULTS

CONSORT flow diagram of the controlled interventional trial

Sixty trial participants with a mean age of 54.4 ± 7.5 years were statistically analyzed. No trial participants had to be excluded during screening or at any point in the study. The study population and the per-protocol population were identical ($n=60$). The flow of subjects through the controlled interventional trial is depicted in a CONSORT (Consolidated Statement of Reporting Trials) conform diagram (Fig. 2).

The study was conducted as a two-arm interventional trial of the test product against placebo for 12 weeks. All enrolled subjects were examined before the first intake of test product or placebo (day 1) and after 12 weeks of intake of test product or placebo (day 85). The safety and efficacy of the test product compared with placebo could be confirmed for the entire study population.

Analyses of collagen structure by confocal microscopy

The application of the confocal laser scanning microscopy procedure provides the opportunity to visualize the collagen structure in the subcutaneous tissue *in vivo*. This method allows a demonstration of the influence of an oral collagen supplement not only on skin characteristics but also especially on the presence of collagen fibers as the most important structural protein of the skin. With the help of a blinded expert grader analyzing such randomly presented microscopy images taken before and after 12 weeks of supplementation of placebo and the test product, a significant improvement of the collagen structure of the facial skin could be demonstrated in response to the test product. Figure 3 shows the different appearances of the collagen structure on day 1 and on day 85 using the example of a single subject (RD47) from the active (verum) intervention group:

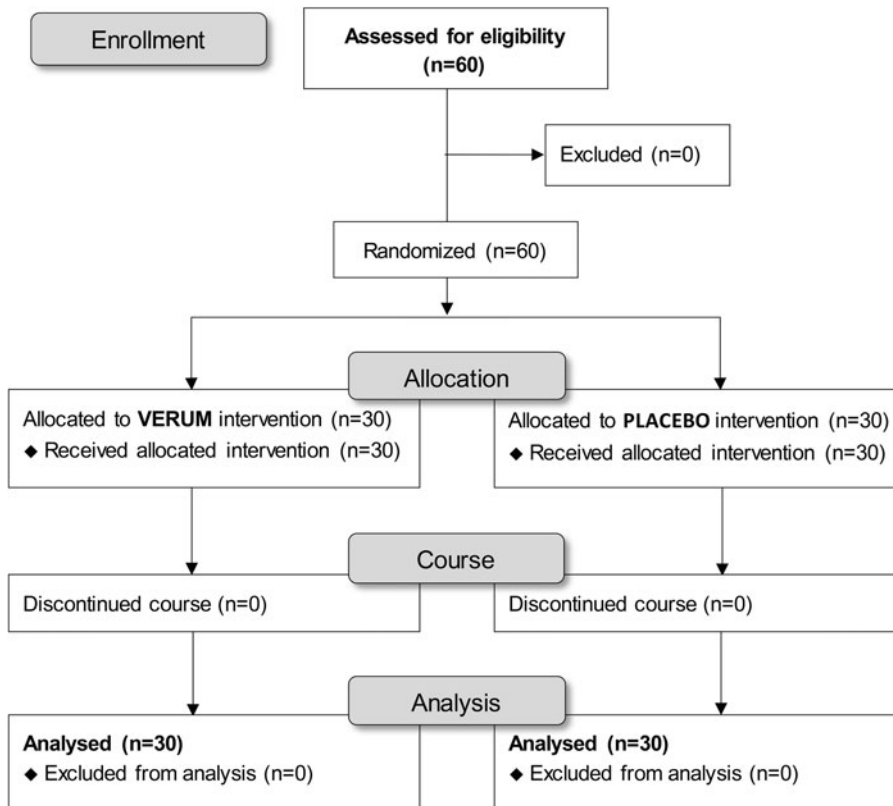


FIG 2. Recruitment of eligible subjects with intervention protocol and assessment.

the evaluation of the collagen structure (*i.e.*, degree of collagen fragmentation) for day 85 (right image) was considerably improved, reflected by an expert rating of +27 within the VAS range of between -50 (left image much better) and +50 (right image much better).

Both the intragroup changes and the intergroup differences confirmed the positive effect of the test product on the human skin. The collagen structure and therefore the quality of the dermis were significantly improved on day 85 compared with benchmark 0 on day 1 after intake of the test product. In contrast, no significant difference to benchmark

0 was detected for placebo. As such, the comparison of treatments revealed a significantly better outcome for the test product than for placebo. Figure 4 demonstrates the improvement of the facial collagen structure by the test product compared with placebo. Intake of placebo resulted in a slight but not significant deterioration of the collagen structure on day 85 compared with day 1.

Analyses of subjective assessments (secondary endpoints)

The analyses of the questionnaire concerning the cosmetic effectiveness of the products revealed a clear overall preference of the test product.

The superiority of the test product compared with placebo becomes clearer through summation of the single scores (“2” = I completely agree; “1” = I agree; “0” = neither...nor; “-1” = I disagree; “-2” = I completely disagree). A higher sum score with a better evaluation for the test product was found (Fig. 5) for all criteria, with the exception of one criterion (Q19) “external care products less often,” with no difference between test product and placebo. The differences in favor of the test product are significant for items regarding skin moisture, suppleness, and softness of skin after product intake. Trial participants noted a superior effect of the test product compared with placebo in all named areas of the body. The best subjective ratings in favor of the test product were found for the backside, legs, neck, and belly, with the most frequently named improvements being “less dry,” “fewer wrinkles,” “more even,” and “more supple.”

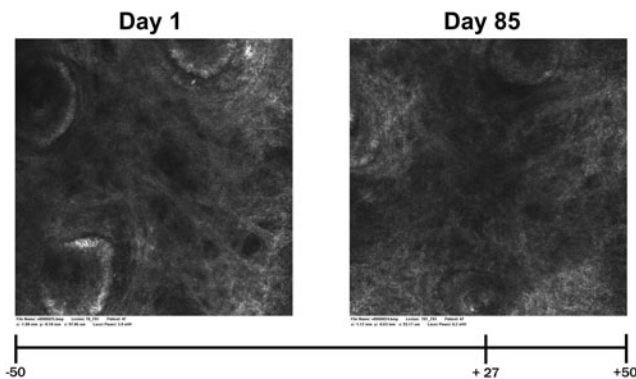


FIG. 3. VIVASCOPE images (subject RD47) showing the collagen structure of the subcutis, taken before (left) and after (right) 85 days of intake of the test product; VAS at the bottom. The blinded expert grader assessed the right image clearly better than the left image with a score of +27 (0=no difference). VAS, visual analog scale.

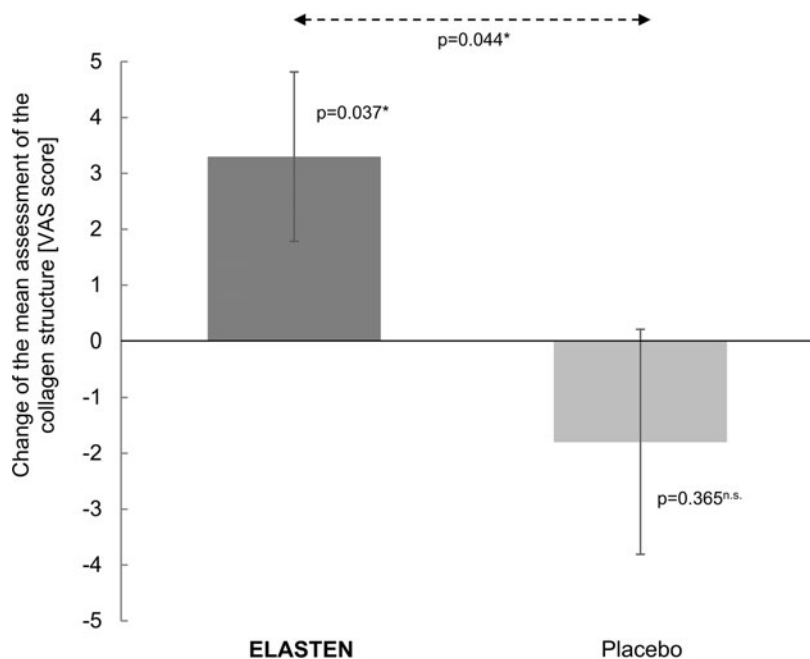


FIG. 4. Appearance of the collagen structure by VIVASCOPE—bar chart with mean values and 95% confidence intervals (test product Elasten®: $n=30$, placebo: $n=30$), VAS: -50 (=day 1 better) to +50 (=day 85 better) (0=no difference); ^{ns}not significant, *significant ($P \leq .05$).

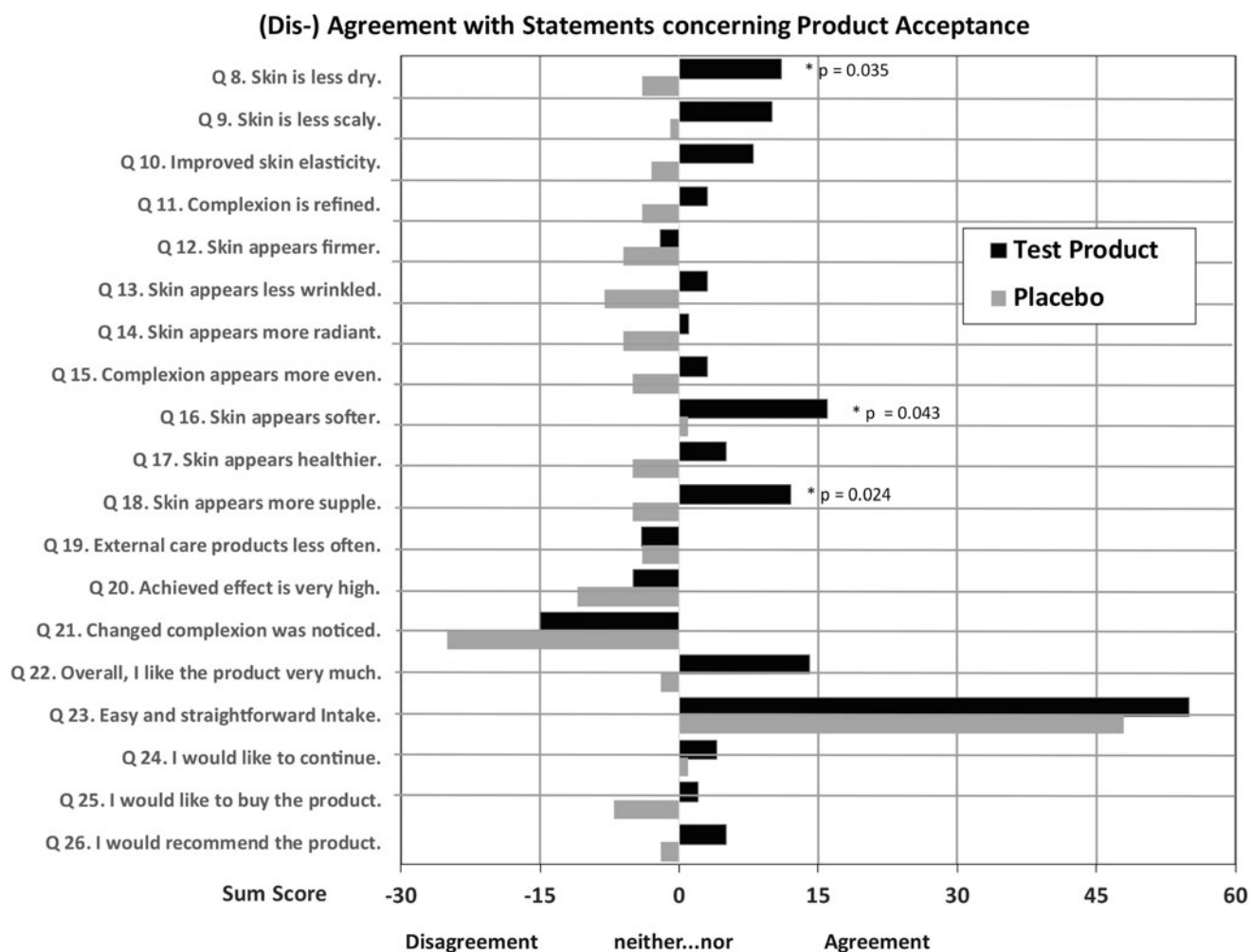


FIG. 5. Results of questionnaire regarding product acceptance on day 85, sum of single scores (“2”=I completely agree; “1”=I agree; “0”=neither...nor; “-1”=I disagree; “-2”=I completely disagree) symbolizing agreement (positive values) or disagreement (negative values) with the product, *black bars*=test product, *gray bars*=placebo, P values shown where differences are significant ($P \leq .05$, one-sided Mann-Whitney-Wilcoxon test).

Tolerability

The tolerance toward the tested products was evaluated very positively by all the trial participants. No adverse effects were reported. The test product was safe and very well tolerated.

DISCUSSION

This randomized, placebo-controlled, triple-blind trial demonstrated the cosmetic effects of a food supplement with special collagen peptides and other dermonutrients on skin quality and collagen structure by means of confocal laser scanning microscopy.

Reduction of assessment bias is essential and increases the accuracy and objectivity. This was achieved by randomization and triple-blinding, through which the treatment modality was unknown to (1) the trial participant, (2) the persons who administered the products, and (3) the person who assessed the outcomes. The expert grader of the confocal laser scanning microscopy images was also blinded regarding the time when the image was taken (pre/post treatment).

Ingestion of collagen peptides can increase collagen synthesis but differ significantly with regard to molecular size and amino acid composition.^{5-7,9-11} The specific bovine collagen peptides of the [HC]-collagen-complex are characterized by a high homogeneity of the amino acid profile with the human collagen protein. Previous peptide mass fingerprinting and liquid chromatography-based proteomic methods have demonstrated a high level of sequence identity of bovine and porcine collagen with human skin collagen.¹² Small cryptic peptides called cryptides together with specific cyclopeptides and matrikines generated from collagen biodegradation and bioresorption can enhance collagen synthesis in humans and can be successfully used to improve, sustain, and maintain skin regeneration, renewal, and repair throughout the entire body.^{5,13}

A high bioavailability as assured by the specific digestion of the oligopeptides to the even shorter bioactive di- and tripeptides formed in the gastrointestinal tract supplies the skin with the specific collagen I and III protein amino acid pattern needed to sustain a sufficient synthesis of the decisive component of the skin biomatrix.^{5-7,10-12} The collagen structure also requires specific cofactors such as vitamin C that are needed for the formation of collagen as well as antioxidants that protect the protein from oxidation.^{14,15} Since aging, stress, and pollution reduce collagen synthesis and thereby negatively impact skin appearance, sufficient nutritional support is a decisive factor.^{1,5,6} The results of this interventional trial demonstrate the measurable cosmetic effectiveness of the test product in improving skin quality. The findings are in line with those of previously published studies investigating the effects of oral collagen supplementation on the dermal collagen network.⁵⁻⁷ The measured positive changes in the structure of connective tissue are clearly associated with functional improvements as reflected by the clear and convincing effects noted in the subjective ratings of the study participants.

This randomized, placebo-controlled, triple-blind trial confirmed the positive cosmetic effects of the collagen-containing food supplement on the quality and appearance of the skin.

AUTHOR DISCLOSURE STATEMENT

No competing financial interests exist.

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