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A QUALITATIVE ASSESSMENT OF THE LABELING INFORMATION OF COLLAGEN-CONTAINING FOOD SUPPLEMENTS

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Abstract. *The use of collagen dietary supplements (CDS) has increased dramatically, creating a large market for these products. With so many options available, it is important for consumers and medical professionals to be well-informed about the composition of these supplements. The aim of this study was to compare the information provided on the labels of CDS with science-based literature. The study conducted an electronic search of randomized, double-blind, control, and pilot studies, which all evaluated the use of oral native or hydrolyzed CDS. All studies were searched in PubMed, and had to be published in English between 2009-2022, August in PubMed. After the initial search, 33 were used for analysis. These studies were then compared to 147 CDS labels registered with the Food Veterinary Service (FVS) in Latvia. The results showed that while studies confirm the benefits of CDS for health, the labels registered in FVS often lack important information about the collagen source, dosage, and duration of use. This results in a significant frequency of errors and potential misuse compared to current scientific knowledge. This makes it challenging for consumers and medical professionals to make informed decisions when purchasing and using collagen supplements.*
Keywords: *collagen, collagen peptides, hair, information quality, joints, skin.*

Introduction

There is a growing interest in collagen nutritional supplements among consumers who believe they may provide health benefits (Albornoz et al., 2020; Grebow, 2020; Grandviewresearch, 2022). Consumers are under the impression that dietary supplements may provide health benefits (Ronan, 2021; Lordan & Rando, 2021). People choose food supplements (FS) because it is simple and time-saving, so it is important to understand which collagen-containing FS is effective.

Manufacturers of collagen-containing food supplements estimate a significant increase in market share within six years (Market Data Forecast, 2022). Therefore, it is important that health professionals provide quality advice to patients and recommend health promotion products that are evidence-based.

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Unfortunately, studies have found that evidence-based sources of information are not always used by pharmacy students and practicing pharmacists (Abahussain et al., 2007; Bukic et al., 2021; Axon et al, 2017).

Nonetheless, the quality of supplement labelling is also vital for informed decision-making. As of 05.08.2022, 147 collagen-containing food supplements are registered on the FVS website. Consumers and medical practitioners need to understand label information to make informed choices (Farmācijas Likums, 1997; Pārtikas un veterinārais dienests, 2015; Pārtikas un veterinārais dienests, n.d.). The **purpose** of this study is to compare the quality of information mentioned in the labels of collagen-containing nutritional supplements registered by FVS with science-based literature.

Research Methodology

We used two protocols for this study, firstly clinical studies were reviewed, and then FS labels were compared to findings.

1. The study included 147 collagen-containing FS objects registered in FVS until June 16, 2022. We followed a protocol and selection process shown in Figure 2 to reach our goal. Three FVS food supplements were excluded for not having enough collagen, being meant for children, or having collagen as an auxiliary substance. A comparison of the research results to these nutritional supplements determined whether these products could potentially affect the health of nails, hair, skin, joints, and connective tissues. The existing selection criteria for Protocol I, in the end resulted in 63 (44.1%) FVS-compliant objects.
2. To study CS registered by FVS, we look at their dose range, extraction source, added active ingredients, and registered selection (Protocol I and Figure 1).
3. *Protocol II* involved the analysis of studies on collagen nutritional supplements and their effects on hair, nails, joints, connective tissue, and skin, published in PubMed in English from 2009 - August 2022. The search was performed using keywords such as "collagen" OR "collagen supplement" AND "nail" OR "nails" OR "skin" OR "joint" OR "bones" OR "hair" and "randomized trial OR pilot study OR clinical trial". The key findings were analyzed using a self-created *Google Docs Spreadsheet* table. A total of 311 data were obtained and further selection was made based on pre-set criteria, as detailed in Figure 1.2. The author followed the PRISMA 2020 flow diagram for new reviews. (Page et al., 2017).

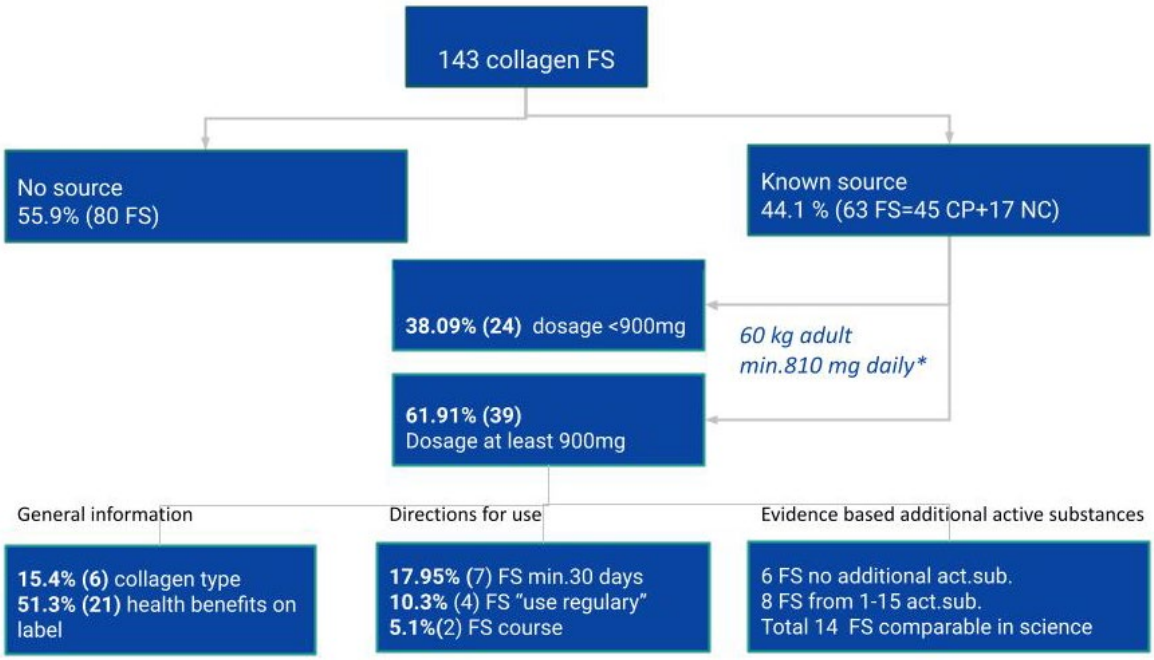

Figure 1 ***Evaluation of the Collagen containing supplements***
*(Kim et al., 2018) CP-collagen peptides, NC - native collagen, AI-active components.

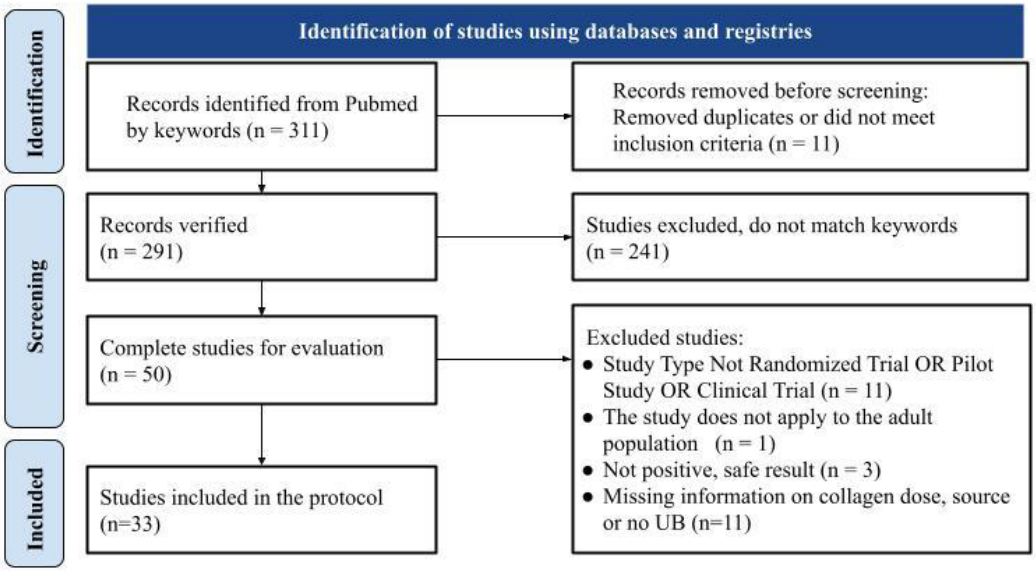

Figure 2 ***PRISMA diagram with modifications*** *(Page et al., 2017)*

4. A self-created *Google Docs Spreadsheet* table included the relevant criteria for each nutritional supplement, including the source of extraction, duration of use, the recommended dose for adults, and any additional active substances included. After applying the criteria, a total of 33 studies about nutritional supplements with collagen support were nominated, of which 31 contained collagen peptides and 2 contained native collagen.

Data analysis: hydrolyzed and native collagen dietary supplement labels were compared to published studies. The results are presented in tables, showing absolute and relative frequency for nominal and category data. We did not consider any existing or potential health complaints of the science-based study audience during data evaluation.

Results of Literature review

Only 33 randomized, double-blind, controlled studies and pilot studies were included in the evaluation.

Collagen is a vital protein in the mammalian body. The human body contains several types of collagen, each with unique functions and properties (Dasong Liu et al., 2015; Ricard, 2011) see Table 1.

Table 1 ***Collagen types*** *(created by the authors)*

Collagen type 1	The most abundant type is found in blood vessels, skin, tendons, bones, and other tissues. It is responsible for the strength and resilience of these tissues.	(Naomi et al., 2021), (Wang, 2021).
Collagen type 2	is important in the development of the eye and is involved in several skeletal disorders, including rheumatoid arthritis and osteoarthritis.	(Honvo et al., 2020), (Walter, K.et al., 2007), (Soh et al., 2022).
Collagen type 3	is found in various organs, including the liver, lungs, and intestines, and plays an important role in wound healing.	(Kuivaniemi & Tromp, 2019).
Collagen type 5	is essential for the fibrillation of collagen types 1 and 3 and is found in the bone and interstitial matrix, corneal stroma, and other organs.	(Leeming,D.J.,& Karsdal,M.A., 2019), (Chen et al., 2020).
Type 1&3	is 95% in the structure of the skin. Responsible for the properties of the skin (strength, turgor, elasticity).	(Chen et al., 2020).

Understanding the specific functions and properties of each collagen type is crucial for developing effective treatments for various diseases and disorders. Furthermore, collagen is also a valuable food source, and its consumption has been linked to several health benefits, including improved skin health and joint pain relief.

The most common sources of collagen supplements (CS) in the FVS are shown in Table 2. Some manufacturers mention only patent information and not

the source of collagen production. The FDA can only remove unsafe products and lacks the authority to assess product quality in advance. There is minimal FDA oversight until harm is reported, and various issues like microbial contamination and fraud have been identified. To address these risks, clinicians should support legislative change, recommend products tested by external labs, and educate patients (White, 2020).

Table 2 ***Evidence-Based information of Collagen Supplement*** *(created by the authors)*

Source of collagen	***Description***	***References***
Cattle, English bovine, cows, goats, sheep, bison, buffalo.	Cows skin is processed to obtain collagen protein, with "grass-fed cattle" label indicating good quality. Type 1 and 3 collagen are mainly obtained. May cause immune responses in 2-4% of people. There are benefits for joint, ligament, skin, and bone health.	(Bruyere et al., 2012), (Gallo et al., 2020) (Benito-Ruiz et al., 2009), (Konig et al., 2018), (Bolke et al., 2019), (Oesser et al., 2013);
Porcine collagen	Skin and bone provide type 1 and type 3 collagen, which is easier to absorb and less likely to cause an immune reaction than bovine collagen. Studies indicate improved joint, ligament, nail, and skin health, with reductions in atopic dermatitis, cellulite.	(Parenteau-Bareil et al., 2011); (Oesser et al., 2013), (Hakuta et al., 2017), (Schunck et al., 2015), (Hexsel et al., 2017), (Zdzieblik et al., 2021)
Eggshells	mostly contain type 1 and type 5 collagen-like material	(Du et al., 2001)
Chicken	improves joints, skin, and osteoarthritis. 4 studies confirm	(Mohammed, & He, 2021), (Schauss et al., 2012), (Schwartz et al., 2019), (Lopez et al. ., 2015)
Marine collagen	Algae and fish collagen (from cod, pangasius, or tilapia skins) are absorbable and improve joint health, skin condition, and aid weight loss. They contain types 1, 2, and 5 collagen with low risk of disease transmission and inflammation.	(Astre et al.,2018),(Corppola et al., 2020), (Carvalho et al., 2018), (Dasong Liu et al., 2015), (Jafari et al., 2020), (Wang et al., 2015), (Nurilmala et al., 2020), (Czajka et al., 2018), (Tak et al., 2019).

Peroral collagen research includes additional active substances such as vitamins, minerals, microelements, bioflavonoids, plant extracts (Lin et al., 2020; Borumand & Sibilla, 2014; Sibilla et al., 2017; Czajka et al., 2018; De Luca et al., 2016; Kanzaki et al., 2016; Schauss et al., 2012; Schwartz et al., 2019; Konig

et al., 2018; Bolke et al., 2019; Bruyere et al., 2012). It's important to check the label for scientific evidence of the benefits of these ingredients before purchasing.

Researchers found the ideal daily collagen dose for a 60 kg adult is between 810-1620 mg/day (Kim et al., 2018). Use duration depends on the collagen source: 8 weeks for pig and beef, 4 weeks for fish, and 6 weeks for chicken. This information is important to include on the label for individuals using collagen.

Research Findings and their Discussion

Eighty (55.9%) out of all FVS collagen and collagen peptide-containing food supplements (refer to Figure 1.), lack information about the source of origin on the label. This poses a potential danger to consumers who have allergies to fish, shellfish, or cattle products (Sharp & Lopata 2014; Porcaro et al., 2019; Luckock et al., 2021; Charen & Harbord, 2020; Kennedy, 2018; Washington (DC): National Academies Press (US), 2005). Additionally, one of the nutritional supplements is targeted at children's health, while two FS labels do not specify the dosage. Lastly, despite searching for the term "collagen" on the FVS website, one nutritional supplement did not contain collagen as an active ingredient.

Hence, there are 63 dietary supplements listed (see Figure 1) in the FVS for further label assessment, out of which 45 supplements contain CP and 17 - contain native collagen (NC).

Based on a literature review, a recommended daily dose for an adult weighing 60 kg is between 810 mg to 1620 mg (Kim et al., 2018). The author also considered the manufacturer's recommendation of at least 810 mg/day, which is based on healthy individuals. Among the 63 supplements, 24 (38.09%) have a lower recommended daily dose, while 39 supplements (61.91%) recommend a dosage ranging from 900 mg to 10,600 mg per day.

Of the 39 supplements registered in the FVS six (15.4%) of food additives mentioned the collagen type on their labels (reg. no. FVS. Native collagen: 8443; collagen peptides: 11339, 13037, 11558, 11631, 11718, 10402), while the remaining 84.6% did not specify the type of collagen used.

Out of 39 FVS CS, 18 (48.7 %) do not specify their intended health benefits, but their source can provide some indication. Seven (17.95%) out of 39 collagen-containing dietary supplements are indicated for a minimum duration of 30 days. Four (10.3%) supplements indicate "use regularly" and two (5.1%) suggest repeating the course several times a year, which is not specific information.

Out of the 143 available dietary supplements, 18 supplements are recommended for at least 1 month and 5 for long-term use. Based on a clinical trial, the duration of use of collagen supplements can range from 2 (Ruff et al., 2018) to 52 weeks (Konig et al., 2018) depending on the type of collagen (collagen peptides or native collagen) and the source of extraction. The arithmetic

mean of 33 studies submitted is 14 weeks. The authors recommend that such information be included on the label of all food supplements containing collagen.

A total of 133 different active substances are listed for all 143 supplement labels, but only 30 have a basis in research. While some supplements provide explanations about the effects of vitamins, references regarding the benefits of collagen use are not always included, potentially limiting consumer understanding. Additional studies indicate discrepancies in the claims made on supplement labels (Avery et al., 2017).

To summarize, out of the 39 available peroral collagen dietary supplements (Figure 1) for which the dose is at least 900mg, only 14 contain active substances with a scientific background. These include porcine source CP with reg. no. 13037, bovine CP with reg. no. 11830, 11832, 12205, and 12304, and fish CP with reg. no. 12732, 10402, 8443, 10228, 11339, 8978, 13266, 9689, 12086. Marine collagen 13718. However, the duration of administration for these nutritional supplements has not been specified.

Further research is needed to address important questions on collagen supplements, such as dose differences for healthy and sick people, the impact of ethnicity and diet, and the effect of other active substances on collagen's bioavailability.

The dietary supplements database provided in the Food and Veterinary Service is often incomplete and generalized, necessitating further labelling of the product. On other hand, the labels can be improved are needed in the database to provide comprehensive information for researchers and consumers (Dwyer et al., 2018, Pereira et al., 2017).

Variable product composition due to a lack of quality control calls for analytical methods to characterize supplement composition (Ambrosio et al, 2020).

Conclusions

A majority (55.9%) of collagen supplements registered in Latvia do not disclose the source of collagen production, making it difficult for consumers to avoid potential allergies and intolerance risks. However, only 19.05% mentioned the type of collagen on the label, allowing consumers to make informed decisions.

Nutritional supplement users should carefully evaluate additional active substances to prevent overdose risks.

Only 11 of the 39 collagen supplements (with a dose at least 900 mg) provided information on the duration of use. Further research is necessary to determine the impact of supplement form, dose, and duration of use. Collagen supplement use duration varies by type and source, as per clinical trial. The authors suggest adding this info to all collagen supplement labels. Drawing upon scientific research data, it can be surmised that out of the 143 collagen-based

nutritional supplements currently available from the Food Veterinary Service. There is sufficient information and a dose of at least 900 mg available for fourteen nutritional supplements, although it may not be comprehensive.

In order to further investigate the scientific validity of the effectiveness of dietary supplements containing collagen, the author plans to conduct an extended study in Latvia. This study will explore the effects of collagen on hair, nails, skin, joints, and bones, and will provide additional data to support the safe and effective use of CS.

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