FORTIGEL® for a Strong Musculoskeletal System
GELITA

• Leading in collagen protein solutions
• Founded in 1875
• Privately owned by founding families
• Headquarters: Eberbach, Germany
• more than 20 sites worldwide
• 2,600 employees
The Role of Collagen

- Biological role of Collagen: adding stability to life
  - Structure protein
  - Collagen fibrils have the tensile strength of steel
- Up to 35% of the whole-body protein content
Collagen in the Human Body

- Collagen is the main component of connective tissue
- Collagen in the musculoskeletal system:
  - Up to 70% of dry cartilage mass (joints, meniscus)
  - Main component of tendons (>85%) and ligaments (>70%)
  - Also abundant in bone, blood vessels and intervertebral disc
  - Accounting for 6% of the weight of strong, tendinous muscles
Collagen – Unique Amino Acid Composition
Collagen – Molecular Structure

- Alpha-chain with 1014 amino acids, coiled into a left-handed helix
- Three alpha chains are twisted around each other into a right-handed super-helix, forming a rigid, rope-like structure with ca. 300 nm length and 1.5 nm diameter
- 4-8 collagen molecules in cross-section form the basic unit to build collagen fibrils.
Collagen Proteins are Safe

- Natural protein
- **Food** – consumed since thousands of years
- **Zero allergenic potential** (mammalian derived)
- Easy to use for consumers
Innovation in Collagen Peptides

Bioactive Collagen Peptides®

- Natural protein / food (clean label, GRAS)
- Zero allergenic potential (mammalian derived)
- High safety level
What are Bioactive Collagen Peptides®?

- A special composition of natural Bioactive Collagen Peptides® obtained by special enzymatic degradation of collagen, optimized for functionality
- FORTIGEL® → Mobility
- Clearly defined by several parameters
- Scientifically validated in pre-clinical and clinical studies
Specific *Bioactive Collagen Peptides*® for Optimized Stimulation of Defined Body Functions

Bioactive Collagen Peptides® are manufactured in a highly specialized and controlled production process.
Performance - Key Parameter in the Development Process

![Bar chart showing type II collagen-synthesis](chart.png)

- Mean MW: 3.0 – 5.0 kDa
- Type II collagen-synthesis [x-fold of control]
GELITA Research Path for Bioactive Collagen Peptides®

Ongoing research activities

Pre-Clinical Investigation

How:
Cell Culture

Objective:
Mode of Action

Pre-Clinical Investigation

How:
Animal Model

Objective:
Mode of Action / Proof of Concept

Clinical Study

How:
Double-Blind, Randomized, Placebo-Controlled

Objective:
Safety & Efficacy in Humans
Bioactive Collagen Peptides®

- Rapidly absorbed, partially in intact form
- Distribution & accumulation in target organ
- Stimulation in target organ

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Iwai et al. (2005)/Beuker et al. (1993)
Bioactive Collagen Peptides®

Rapidly absorbed, partially in intact form

Distribution & accumulation in target organ

Stimulation in target organ

Accumulation of FORTIGEL® peptides in cartilage tissue

Bioactive Collagen Peptides®

- Rapidly absorbed, partially in intact form
- Distribution & accumulation in target organ
- Stimulation in target organ

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“Tendons are subject to many types of injuries. [...] The extrinsic factors are often related to sports and include excessive forces or loading, poor training techniques, and environmental conditions.”

Expression of Extracellular Matrix molecules in Human Cruciate and Hip Ligament Cells

In cruciate and hip ligaments a significantly increased collagen and elastin expression was measurable after treatment with FORTIGEL® (n > 14; *p < 0.05).

In-vitro test – RNA expression with FORTIGEL® Collagen Peptides
Stimulation of Extracellular Matrix Molecules in Ligaments

Significant increase of collagen, proteoglycans and elastin biosynthesis after treatment with FORTIGEL® (n > 8; p < 0.05)

GELITA data: In-vitro test with FORTIGEL® Collagen Peptides
Expression of Extracellular Matrix molecules in Tenocytes

Significant increase of collagen, proteoglycan expression after treatment with FORTIGEL® (n > 12; *p < 0.05)

In vitro test – RNA expression with FORTIGEL® Collagen Peptides
Biomechanical In-Vivo Pilot Study

- 24 volunteers, aged 24-65 (mean 46.9 years) with no hand injuries /deformations
- Supplementation with 10g Bioactive Collagen Peptides® / 6 months

* Weh et al., Orthopaedica 4/2001, p.12-16, “Change in the Properties of Tissue Through the Administration of Gelatine – A Biomechanical In-Vivo Pilot Study

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Saluto Injury Study

- 1,150 athletes were controlled over 2 years
- 3 categories of athletes
  - 398 Professional soccer and handball players (Training 14-18h per week)
  - 397 Endurance athletes (Training more than 10h per week)
  - 397 Weekend warriors (Training 4-6h per week)
- All categories were divided into 2 groups (6 groups in total):
  - One group received no nutritional intervention
  - One group received an individual nutritional intervention
- Nutritional intervention:
  - Collagen Peptides enriched with BCAA and Arginine (30-70g / day)
    plus Vitamins, Minerals and Trace elements
- Parameter:
  Number of injuries on muscle, joint, ligaments and tendons without contact with a competitor during the period of 2 years
Risk of Injuries - Tendons, Ligaments, Joints and Muscles without External Impact (in %)

- Without Supplementation (n = 591)
- With Nutrient Supplementation (n = 559)

Professional athletes: Handball / Soccer Training 14-18h per Week
- 79% (n=193)
- 12% (n=203)
- 67% reduction

Endurance athletes: Training >10h per Week
- 60% (n=199)
- 8% (n=178)
- 52% reduction

Weekend Warriors: Training 4-6h per Week
- 58% (n=199)
- 4% (n=178)
- 54% reduction

Sports and Joint Health

“Bodybuilding can be extremely hard on the joints and muscles. Most bodybuilders lift hundreds of tons of weights during their career. This can subject them to many different injuries”
FORTIGEL® - How does it Work?

Composition of joint cartilage

- Proteoglycans: ca. 25%
- Collagen: ca. 70%
- Cells & Miscellaneous

FORTIGEL affects 95% of the Cartilage.

Stimulation of cartilage regeneration

(postulated mode of action)
FORTIGEL® - Promotes Joint Cartilage Regeneration

Change in the joint cartilage after 3 months (tissue sections)¹

Progression without FORTIGEL®

Progression with FORTIGEL®

¹ Oesser S et al. (2007) Osteoarthritis Cartilage 15: C61-C62, 94
# FORTIGEL® - Clinical Evidence

| Investigator            | Published | Subjects | Study design                                                   |
|-------------------------|-----------|----------|                                                               |
| Krug                    | 1979      | 183      | open                                                           |
| Götz                    | 1982      | 60       | open                                                           |
| Oberschelp              | 1985      | 154      | comparative                                                    |
| Seeligmüller            | 1989      | 356      | open                                                           |
| Adam                    | 1991      | 81       | double-blind, placebo controlled, randomized, crossover        |
| Seeligmüller            | 1993      | 519      | open                                                           |
| Beuker, Eck             | 1996      | 40       | open                                                           |
| Beuker, Rosenfeld       | 1996      | 100      | double-blind, placebo controlled, randomized                   |
| Moskowitz               | 2000      | 389      | double-blind, placebo controlled, randomized                   |
| Rippe                   | 2004      | 250      | double-blind, placebo controlled, randomized                   |
| Rippe                   | 2005      | 102      | double-blind, placebo controlled, randomized                   |
| Flechsenhar, Alf        | 2005      | 100      | open                                                           |
| Clark                   | 2008      | 147      | double-blind, placebo controlled, randomized                   |
| McAlindon               | 2009      | 30       | double-blind, placebo controlled, randomized                   |
Observational Study “Olympiastützpunkt Rhein-Ruhr” (2005) - Joint Health Improvement for Healthy Adults

Design:
- Open label
- 100 active individuals (age 15-80) with joint pain or joint discomfort
- Therapy: 10 g FORTIGEL®
- 12 weeks trial
- Pain, mobility, flexibility, different joints

Results
Consumption of FORTIGEL® showed significant improvements in individuals with joint problems

Clark et al. (2008) Current Medical Research and Opinion 14, 5 / 1485 - 1496
PennState University Study (2008) Confirms Joint Health Effect in Healthy Athlete Students

Design:
- Randomized, double blind, placebo controlled
- 147 individuals with joint pain or joint discomfort (student athletes)
- Therapy: 10 g FORTIGEL® or placebo
- 24 weeks trial
- pain, mobility, flexibility, different joints

Results
- Significant improvements in joint problems (especially in knees)
- Increase of physical performance & mobility
- Decrease of alternative therapies (massages, ice packs)

Clark et al. (2008) Current Medical Research and Opinion 14, 5 / 1485 - 1496
USOC Track & Field Resident Program: Product Trial

• American College of Sports Medicine 2011: medical groups used a combination of dietary collagen and protein to improve post-surgical recovery. Presented data was positive, but lacked clinical significance and required further investigation.

• The USOC Track and Field program was provided with CH-alpha product [FORTIGEL®] to trial on relevant athletes (ongoing degenerative conditions, musculoskeletal surgery, achilliss and knee injuries).

• **Product trial** with 15 athletes / self-reported efficacy:
  • Majority of athletes (n=10) believe it works
  • One athlete with particularly bad degenerative knee issues spoke highly of the product, especially with reduction in pain and improved daily mobility

Report to GELITA by Andrea Braakhuis, USOC Senior Dietitian
Strong Musculoskeletal System & Mobility - Relevant Topics for Athletes

- Hyperextension (= stretching of joints / tendons beyond the normal range of motion) is not intentional and often results in orthopedic injury - especially in athletes\(^1\)
- Increased prevalence of knee osteoarthritis among athletes\(^2\)
- Cartilage injuries, common in young and middle aged active adults, often precedes osteoarthritis\(^2\)

\(^1\) Weh et al., Orthopaedica 4/2001, p.12-16, “Change in the Properties of Tissue Through the Administration of Gelatine – A Biomechanical In-Vivo Pilot Study.”
Protein Based Supplements – With Additional Physiological Benefits

Nutritional advantage

- Natural protein / food
- High safety profile
- Unique amino acid composition
- Non-allergenic

Physiological benefits

- Cartilage renewal
- Strong tendons & ligaments
- Stimulation of connective tissue formation

Keep athletes performing, active and mobile!
Thank you!

Questions?
Tonja Lipp
tonja.lipp@gelita.com
(609) 955 1639