A TECHNICAL WHITE PAPER

Chitosan in *Oral Care.*

PREPARED FOR

Chitosan Global commercial team, formulators & prospective B2B buyers.

SCOPE

Carboxymethyl chitosan, chitosan hydrochloride, COS lactate, quaternary chitosan.

Scientific evidence, material comparisons, and formulation implications — distinguishing what the literature supports from what it merely suggests.

THESIS · The strongest peer-reviewed signals for chitosan in the mouth concentrate on **CMCS-driven biofilm interference and enamel/dentin remineralization**; salt form, source, and chemistry determine where each grade actually belongs in a formula.

CARBOXYMETHYL CHITOSAN · CMCS

The strongest oral-care signal in the chitosan family.

Peer-reviewed work concentrates on two mechanisms: biofilm interference against *Streptococcus mutans* and biomimetic remineralization of dentin & enamel.

MECHANISM 01

Biofilm interference & *S. mutans* suppression

CMCS / amorphous-calcium-phosphate nanocomplexes reduce oral bacterial adherence and biofilm formation on human enamel.

Narrative and systematic reviews report that chitosan polymers inhibit *S. mutans* biofilm formation and acid production — the cariogenic mechanism that drives caries onset.

[1] PMC10570529 [2] PMC12537699

MECHANISM 02

Enamel & dentin remineralization platform

CMCS stabilizes amorphous calcium phosphate and templates intrafibrillar mineralization of demineralized dentin lesions.

Experimental resins releasing CMCS sustain Ca & P delivery, supporting remineralization of early caries — positioning CMCS as a fluoride-adjacent or fluoride-alternative platform under study.

[1] PMC10570529 [3] PubMed 38003281

FORMULATION FIT

Water-soluble, mucoadhesive, gel-ready

The carboxymethyl substitution gives CMCS true aqueous solubility at near-neutral pH — unlike native chitosan, which needs acid activation.

That property is what makes CMCS the form most often recommended for toothpaste gels, mouthwashes, and oral-delivery systems.

Chitosan Global · CMCS & toothpaste pages

SOURCES · [1] Qu et al., Front. Bioeng. Biotechnol., PMC10570529 · [2] Applications of chitosan in oral health & diseases, PMC12537699 · [3] Chitosan use in dentistry – systematic review, PubMed 38003281 · [4] chitosanglobal.com / carboxymethyl-chitosan & chitosan-toothpaste

MUSHROOM / FUNGAL SOURCE

A *positioning* advantage — not a clinical one.

Fungal-source chitosan supports non-shellfish & hypoallergenic labelling, vegan-compatible procurement, and ESG sourcing — but is not, on its own, evidence of superior oral-care efficacy.

WHAT IT EARNS YOU

Defensible label & channel access

01 **Non-shellfish, hypoallergenic positioning.** Oyster-mushroom mycelium origin removes the crustacean-allergen flag that gates shellfish-derived chitosan in oral products.

02 **Vegan-compatible procurement.** Zero-animal-input chain — qualifies for plant-based and ESG-aligned retail listings.

03 **Batch uniformity.** Fermentation-controlled mycelium yields a cleaner molecular profile than seasonally-varying shellfish chitin.

WHAT IT DOES NOT EARN

A claim of superior oral efficacy

Published comparative studies in the cited oral-care literature do **not** isolate fungal vs. shellfish chitosan as the variable driving biofilm inhibition or remineralization outcomes.

The mechanistic actors are well-documented — degree of deacetylation, molecular weight, salt form, and derivative chemistry (CMCS, COS, quaternary). Source matters for *positioning*; chemistry matters for *performance*.

Recommendation: sell mushroom-source on label / allergen / sustainability terms — keep efficacy claims tied to the derivative, not the origin.

SOURCES · chitosanglobal.com / product / chitonova-60-fg (mushroom source details) · PMC12537699 (chitosan in oral health & diseases – derivative-driven mechanisms) · PMC10570529 (anti-caries mechanisms tied to chemistry, not origin)

FOUR GRADES · ONE DECISION FRAMEWORK

Which chitosan belongs in *which* oral-care formulation.

ATTRIBUTE	DERIVATIVE 01 Carboxymethyl chitosan	DERIVATIVE 02 Chitosan hydrochloride	DERIVATIVE 03 COS lactate	DERIVATIVE 04 Quaternary chitosan
CHEMISTRY	Anionic / amphoteric carboxymethyl-substituted chitosan	HCl-salt of chitosan; cationic in protonated form	Lactate salt of low-MW chitosan oligosaccharide (<3,000 Da)	Quaternary-ammonium-grafted chitosan — permanent cation
SOLUBILITY	Water-soluble at near-neutral pH — gel-ready	Water-soluble; well suited to mouthwash & rinse vehicles	Complete water solubility, neutral–slightly acidic; no acid activation	Fully water-soluble across a wide pH range incl. physiological
CHARGE BEHAVIOUR	pH-dependent; amphoteric — interacts with Ca^{2+} & mineral phases	Cationic only when amino groups are protonated (acidic-leaning pH)	Cationic; supplier-page **+60 mV** zeta claim (≥95% DDA, >99% purity)	**Permanently cationic** — activity persists at neutral / physiological pH
STRONGEST EVIDENCED ROLE	**Biofilm interference & remineralization** in dentin/enamel models	**Vehicle / mouthwash & oral-delivery base** — water-soluble carrier	Cationic membrane-disruption mechanism; product-page claim, not isolated oral RCT	**Broad-pH antimicrobial systems**, hydrogels & surface coatings
DEPLOY IN	Remineralizing toothpaste gels, anti-caries adjuncts, sensitivity formulations	Mouthwashes, rinses, dissolvable oral films, soluble dispersions	Clean-label preservative & mild-acid oral vehicles where lactate counterion is preferred	Sustained-release antimicrobial coatings, dental-device finishes, hydrogel carriers

Decision rule · Match the derivative to the dose form: CMCS → gel/paste · HCl → rinse · COS lactate → mild-acid clean-label · Quaternary → durable cationic surface activity.

SOURCES · chitosanglobal.com / carboxymethyl-chitosan, chitosan-hydrochloride, product/chitonova-60-fg, quaternary-chitosan-for-antimicrobial-systems · MDPI Polymers 13(15) 2514 (quaternized chitosan)

WHAT THE EVIDENCE ACTUALLY SUPPORTS

Two industry claims — graded against the literature.

Buyers and formulators repeatedly ask about two specific claims. Here is the conservative read.

SUPPORTED

CLAIM · 01

“Quaternary chitosan delivers permanent cationic, broad-pH antimicrobial activity.”

Quaternization grafts a permanent positive charge onto the chitosan backbone, decoupling cationic antimicrobial activity from protonation. The polymer therefore remains active in neutral and physiological pH environments where native chitosan loses charge.

Evidence read. Peer-reviewed work on quaternized chitosan (MDPI *Polymers* 13(15) 2514; PMC9014838) documents superior water solubility, augmented antimicrobial activity, and broad-pH performance — the strongest mechanistic basis among the four derivatives reviewed.

[5] MDPI Polymers 13(15) 2514 [6] PMC9014838 chitosanglobal.com/quaternary-chitosan…

SUPPLIER DATA · USE WITH CARE

CLAIM · 02

“COS lactate carries a +60 mV zeta potential driving its antimicrobial mechanism.”

The cationic membrane-disruption model is well-established in the broader chitosan literature. The specific “+60 mV” figure, however, originates on the Chitonova-60 FG product page (≥95% DDA, >99% purity, ~+50 to +70 mV stated range).

Discipline. Reference the +60 mV value as a *supplier specification* for the Chitonova-60 FG grade, not as a generalized claim for “chitosan oligosaccharide.” Pair it with cited mechanism literature; do not present it as an independently-validated oral-care RCT endpoint.

chitosanglobal.com/product/chitonova-60-fg · mechanism context: PMC4264197, PMC12537699

SOURCES · [5] Biomedical applications of quaternized chitosan — MDPI Polymers 13(15) 2514 · [6] Chitosan antibacterial / biofilm review — PMC9014838 · [7] Antimicrobial activity of chitosan against oral microbiota — PMC4264197 · chitosanglobal.com / chitonova-60-fg

THE FOUR-LINE TAKE-AWAY

Match the *derivative* to the *dose form*.

01	**CMCS**	Lead with biofilm interference + remineralization. The mechanism most peer-reviewed work actually supports.
02	**Mushroom source**	Sell on label, allergen, vegan, and ESG terms — never as a clinical efficacy claim.
03	**HCl & COS lactate**	Water-soluble carriers for rinses & clean-label oral vehicles; +60 mV is a Chitonova-60 FG spec, not a category claim.
04	**Quaternary chitosan**	Best-supported broad-pH, permanently cationic platform — surface, coating, and hydrogel applications.

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