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Review

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Tart cherry supplementation for exercise recovery: an evidence-informed narrative review and applied monitoring framework

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[Purpose] This review synthesizes evidence on tart cherry juice supplementation for recovery after exercise-induced muscle damage (EIMD) and develops an expert-informed applied framework for sports nutrition practice.

[Methods] This evidence-informed narrative review, supported by a structured literature search, prioritized peer-reviewed human experimental studies (especially randomized placebo-controlled trials), with systematic reviews and meta-analyses used for contextualization. The outcomes included delayed-onset muscle soreness (DOMS)/perceived recovery, neuromuscular recovery (strength/power), and biochemical indices of muscle damage and inflammation. The interpretation considered training status, exercise model (eccentric, endurance, intermittent), supplement form, timing architecture, and assessment windows.

[Results] The proposed anti-inflammatory and antioxidant mechanisms did not consistently translate into functional benefits in different contexts. Favorable signals are more frequent for soreness and perceptual outcomes, whereas strength/power findings are mixed and condition-dependent, and biochemical responses are heterogeneous and difficult to interpret in isolation. Several controlled trials have reported null effects, indicating potential limitations to efficacy related to population characteristics, protocol design, dosing/composition, and outcome timing.

[Conclusion] Tart cherry juice is best interpreted as a context-dependent adjunct during high recovery-pressure periods (e.g., congested fixtures, short turnarounds, travel) rather than as a universal daily intervention. Given the theoretical concerns regarding adaptation blunting with chronic antioxidant exposure and limited long-term data, a periodized approach is warranted. Further, potential sponsorship/publication bias should be considered when translating the evidence into practice.

[Keywords] anthocyanins, delayed-onset muscle soreness, exercise-induced muscle damage, sports nutrition, tart cherry juice, recovery

INTRODUCTION

Exercise-induced muscle damage (EIMD) is a common physiological response to high-intensity, unaccustomed, or eccentric-biased exercise[1-4]. Its practical manifestations include delayed-onset muscle soreness (DOMS), transient decreases in strength and power, and short-term increases in inflammatory and oxidative stress responses[2,3]. Under limited recovery windows, these responses are not merely laboratory observations; they can directly undermine next-session readiness and subsequent competitive execution. In sports characterized by congested fixtures, tournament formats, repeated high-intensity exposure, or frequent travel, delayed recovery can reduce athlete availability and destabilize performance consistency[5,6].

In this context, sports nutrition has increasingly focused on interventions that may accelerate short-term recovery while remaining compatible with broader training and competition objectives[7]. Tart cherry juice has emerged as one of the most extensively studied food-based recovery strategies[4,8]. Early randomized controlled trials reported reduced post-exercise pain and attenuation of strength loss[1,2]. Subsequent work in endurance settings, including marathon models, has suggested favorable changes in selected recovery-related outcomes[3,9]. However, as the literature expands, interpretation needs to become more nuanced; contemporary systematic reviews and meta-analyses generally support potential benefits in selected domains while repeatedly emphasizing substantial between-study heterogeneity[10-13,16].

However, these prior syntheses primarily quantified pooled effect sizes and overall magnitude of change and do not provide a structured approach for translating heterogeneous protocols, exercise models, or outcome timing into applied decision-making. Differences in supplement composition, dosing architecture, and operational context complicate the direct implementation of meta-analytical conclusions in real-world performance environments. Therefore, the unique contribution of the present review is not a new quantitative synthesis but a practitioner-oriented translational integration of the existing evidence base.

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This heterogeneity is methodologically important rather than incidental. Under the same umbrella term "tart cherry juice," studies differ in anthocyanin/polyphenol density, concentration, processing conditions, sugar profile, and composition-reporting quality[10,12-14]. The protocols also vary in pre-loading duration, day-of timing, intake frequency, and post-exercise continuation[10-13,16]. Similarly, endpoint selection is inconsistent: DOMS may improve, while creatine kinase (CK) and C-reactive protein (CRP) remain unchanged, or certain biochemical shifts may occur without a clear transfer to functional performance[11,17]. Therefore, tart cherry juice should not be interpreted as uniformly effective across all athletes, exercise models, and operational contexts[11,12].

From an applied perspective, the central issue is less about whether all biomarkers move in the same direction and more about whether recovery support improves execution of the next required session under real scheduling constraints[5,6,15]. In high-pressure environments, even modest improvements in soreness and neuromuscular readiness may result in meaningful operational value. Accordingly, this review aims to (1) summarize biological plausibility; (2) integrate outcome-level evidence across perceptual, neuromuscular, and biochemical domains; (3) analyze major sources of heterogeneity; and (4) develop an expert-informed, scenario-based translational implementation and field-monitoring framework intended to support practitioner decision-making[4,10,12].

METHODS

This study was conducted as an evidence-informed narrative review, supported by a structured literature search. Searches were performed in PubMed/MEDLINE, SPORTDiscus, Scopus, and Web of Science from database inception to February 2, 2026. Search strings combined tart cherry supplementation terms (e.g., "tart cherry" OR Montmorency OR *Prunus cerasus* OR cherry juice OR cherry concentrate OR cherry powder/capsule) with exercise and recovery constructs (e.g., exercise OR training OR eccentric OR endurance OR intermittent OR EIMD OR DOMS OR soreness OR recovery OR strength OR power OR creatine kinase OR C-reactive protein OR inflammation OR oxidative stress), using Boolean operators and database-specific syntax.

Eligibility criteria were defined a priori. We included peer-reviewed human studies evaluating tart cherry supplementation (juice, concentrate, powder/capsules) in the context of an exercise bout or training exposure with recovery demand and reporting at least one outcome within our primary outcome domains: (1) DOMS and perceived recovery, (2) neuromuscular recovery (strength and power), and (3) biochemical indices related to muscle damage and inflammation (e.g., CK, CRP)[2,3,9,11,17]. Randomized placebo-controlled trials were prioritized for primary interpretation, and systematic reviews/meta-analyses were used to contextualize the evidence base[1-4,10-13]. We excluded non-human studies, non-tart cherry interventions, and multi-ingredient formulations in which tart cherry-specific effects could not be isolated.

Study selection was conducted in two stages (title/abstract screening, followed by full-text review), and data extraction was performed by a single reviewer. To enhance consistency, eligibility criteria were defined a priori and records were re-checked at the full-text stage prior to synthesis. Study quality and potential bias were appraised using RoB 2 for randomized trials and AMSTAR 2 for systematic reviews. Appraisal outcomes were qualitatively incorporated into the interpretation rather than as quantitative weights.

During synthesis, the findings were interpreted by jointly evaluating participant characteristics (e.g., training status), exercise model (eccentric-damage protocols, endurance events, repeated/intermittent high-intensity contexts), supplement format (juice or concentrate), timing architecture (pre-load, day-of, post-exercise continuation), and measurement windows[10-14,16]. Practical relevance in repeated training and competition settings was also considered a translational interpretation target[5,6,15]. Because substantial heterogeneity in product composition and protocol design limits direct comparability, de novo quantitative pooling was not attempted. Instead, evidence was integrated qualitatively, with an explicit emphasis on translational interpretability for sports nutrition practice[10-13]. Although a structured search and appraisal were applied, this work remains a narrative synthesis rather than a formal systematic review; therefore, the possibility of selection and publication bias cannot be fully excluded. Accordingly, the PRISMA-ScR framework was not formally applied, because the objective of the present review was to provide a translationally oriented narrative synthesis rather than a comprehensive scoping review. The characteristics of all included randomized controlled trials are summarized in Table 1.

Overall, the risk-of-bias appraisal suggested that the randomized trial literature was characterized predominantly by low risk or some concerns rather than uniformly high risk. However, several recurring methodological limitations were noted, including small sample sizes, incomplete reporting of allocation concealment, limited pre-registration transparency, and inconsistent characterization of anthocyanin and total polyphenol content across products. For systematic reviews, AMSTAR 2 appraisal indicated that interpretive confidence was further constrained by heterogeneity in study design, supplement formulation, and outcome timing. Accordingly, appraisal findings were incorporated qualitatively into evidence interpretation rather than being used as strict exclusion criteria. Greater interpretive weight was given to findings reproduced across comparable exercise models and outcome domains, whereas conclusions regarding dose equivalence, long-term adaptation, and broader population generalizability were interpreted more cautiously.

Mechanistic Rationale for Tart Cherry Juice in Post-Exercise Recovery

The mechanistic effects of tart cherry juice are primarily linked to anthocyanin-rich polyphenol compounds and their potential interactions with post-exercise inflammatory and

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Table 1. Characteristics of randomized controlled trials investigating tart cherry supplementation and exercise recovery

Study	Population	Exercise model	Supplement (form & dose)	Timing protocol	Outcomes assessed	Main findings
Connolly et al., 2006[1]	n = 14, untrained men	Eccentric elbow flexion	Tart cherry juice blend (~710 mL/day; 355 mL × 2/day)	3 days pre + exercise day + 4 days post	MVC, DOMS	↓ DOMS; faster recovery of MVC
Kuehl et al., 2010[8]	n = 54, recreational runners	Distance running	Tart cherry juice (~710 mL/day; 355 mL × 2/day)	7 days pre-race + race day	DOMS	↓ DOMS
Howatson et al., 2010[3]	n = 20, recreational marathon runners	Marathon	Tart cherry juice concentrate (30 mL × 2/day)	5 days pre + race day + 2 days post	CRP, IL-6, MVC, CK, LDH, DOMS	Reduced inflammatory markers; faster recovery of MVC; no clear effect on CK, LDH, soreness
Bowtell et al., 2011[2]	n = 10, trained men	Eccentric knee extension	Tart cherry juice concentrate (30 mL × 2/day)	7 days pre + exercise day + 2 days post	MVC, CK, hsCRP, protein carbonyls	Faster recovery of MVC, ↓ protein carbonyl response; no clear effect on CK
Bell et al., 2016[29]	n = 16, semi-professional male soccer players	Prolonged intermittent exercise	Tart cherry juice concentrate (30 mL × 2/day)	4 days pre + exercise day + 3 days post	MVC, CMJ, agility, DOMS; IL-6, hsCRP, CK, lipid hydroperoxides	Faster recovery of MVC, CMJ, agility; ↓ DOMS; ↓ IL-6; no clear effect on CK, lipid hydroperoxides
Brown et al., 2019[11]	n = 20, trained women	Eccentric knee extension	Tart cherry juice concentrate (30 mL × 2/day)	4 days pre + exercise day + 2 days post	MVC, DOMS	Faster recovery of MVC; no clear effect on DOMS
Lamb et al., 2019[32]	n = 36, non-resistance-trained men	Eccentric elbow flexor exercise	Tart cherry juice (2× 250 mL/day)	4 days pre + exercise day + 4 days post	MVC, DOMS, CK, ROM	No significant effect
Quinlan & Hill, 2020[28]	n = 20, team-sport players	Loughborough intermittent shuttle test	Tart cherry juice concentrate (30 mL × 2/day)	5 days pre + exercise day + 2 days post	CMJ, 20 m sprint, MVC, DOMS, CK, CRP	Faster recovery of CMJ, sprint, MVC; DOMS inconclusive; no effect on CK/CRP
Ortega et al., 2023[33]	n = 17, recreationally active women	Intense leg-extensor exercise	Tart cherry capsule (1,000 mg/day)	8 days	DOMS, MVC, EMG	No significant effect
Squires et al., 2024[34]	n = 22, recreationally active adults	Maximal eccentric elbow flexion	Vistula TC spray-dried extract capsules (5.1 g × 2/day)	Exercise day + 3 days post	MVC, DOMS, PPT, ROM, arm girth	No significant effect
Gao et al., 2024[27]	n = 12, recreational cyclists	Cycling endurance	Tart cherry juice (150 mL × 2/day)	4 days pre + 2 days post	MVC, low-frequency fatigue, DOMS	No significant effect
Hagele et al., 2026[22]	n = 40, healthy active adults	Repeated sprint exercise	Powdered tart cherry (500 mg/day)	7 days pre + exercise day + 2 days post	CMJ, IMTP, MVC, Wingate, VAS, CK	No significant effect

Abbreviations: CK, creatine kinase; CMJ, countermovement jump; hsCRP, high-sensitivity C-reactive protein; DOMS, delayed-onset muscle soreness; EMG, electromyography; IL-6, interleukin-6; IMTP, isometric mid-thigh pull; LDH, lactate dehydrogenase; MVC, maximal voluntary contraction; PPT, pressure pain threshold; ROM, range of motion; TC, tart-cherry; VAS, visual analog scale

redox pathways[14,18-20]. EIMD cannot be explained solely by initial mechanical microtrauma. Instead, the initial insult is frequently followed by a secondary cascade involving immune signaling, inflammatory mediation, and oxidative-stress amplification[18,21]. When this secondary response is excessive or prolonged, soreness perception can intensify, restoration of neuromuscular function can be delayed, and return to baseline readiness can be prolonged[18,21].

From this perspective, tart cherry juice is better interpreted not as a direct anti-damage treatment, but as a potential modulator of the recovery trajectory following the onset of exercise-induced muscle damage[4,10,12]. This distinction is conceptually important. The expected benefits are more plausibly linked to the attenuation of excessive secondary responses than to a complete suppression of physiological signaling. The same framework helps explain why perceptual and functional improvements can coexist with mixed biochemical findings across studies[10,11,17].

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At the same time, inflammatory and oxidative signals are not purely pathological; they are also components of adaptive exercise biology[18,21]. Therefore, mechanistic plausibility should not be overextended into universal dosing assumptions. Current evidence supports biological plausibility, but applied decisions on frequency, duration, and context should remain anchored to performance constraints and observed response patterns in the field.

Effects on Perceptual Recovery: DOMS and Recovery Perception

Although DOMS is categorized as a subjective endpoint, in applied sports, it functions as an operational readiness marker[5,15]. Elevated soreness may alter movement behavior, reduce confidence in high-force and high-velocity actions, and impair technical reproducibility. These consequences can reduce both the quality and quantity of planned training exposure, especially when session density is high and recovery windows are narrow.

Across the literature on tart cherry, one of the most recurrent favorable signals appears in perceptual recovery outcomes, particularly soreness indices[1-4,9,11]. This pattern has been observed in both endurance and muscle damage models and appears to be most relevant in the early post-exercise period (approximately 24-72 h)[2,3,9], which is often the critical interval for re-entry into high-quality practice or competition[5,6,15].

Importantly, practical value should not be judged solely by the absolute effect size. Even modest reductions in soreness may improve warm-up execution, technical focus, completion of planned sets/repetitions, and overall adherence to daily training prescriptions[5,15]. Under congested competitive calendars, these small gains can accumulate and translate into meaningful improvements in athletic availability and performance stability[5,6]. Therefore, DOMS findings should be interpreted using both statistical and operational lenses.

Effects on Neuromuscular Recovery: Strength and Power Outcomes

Neuromuscular restoration (strength and power) is the most direct bridge between recovery science and performance operations[5,15]. For practitioners, the key question is not only whether pain decreases but also whether the athlete can reproduce the required output in the next session with acceptable quality and consistency.

Early controlled studies reported the attenuation of post-exercise strength loss with tart cherry interventions[1,2], and later investigations extended this line of inquiry across broader exercise contexts[9,11,27,30]. Recent team-sport evidence further extends this domain, with tart cherry supplementation being associated with improved lower-limb functional recovery and movement-related outcomes in competitive soccer players[31]. The overall evidence suggests potentially meaningful effects under selected conditions but not uniform effects across all models[10-13,16]. This variability is physiologically plausible; marathon-induced systemic fatigue, eccentric resistance-induced local damage, and repeated-sprint neuromuscular stress represent distinct recovery problems with different kinetics[3,9,16,21].

Accordingly, the interpretation should be context-specific rather than binary. The applied question is not "Does tart cherry always work?" but "Under what load structures and schedule constraints does it generate actionable benefit for this athlete or team?" Repeated low-burden field metrics—such as countermovement jumps, isometric indicators, or standardized short power tests—provide practical evidence to answer this question[5,15,26]. In many settings, reduced performance drop, faster baseline restoration, and better session-to-session reproducibility are more operationally meaningful than isolated single-timepoint differences.

Effects on Biochemical Markers

Biochemical markers (e.g., CK, CRP) remain central to EIMD research but are inherently difficult to interpret in isolation[16,17,25]. First, inter-individual variability is substantial, indicating that similarly loaded athletes may exhibit markedly different response amplitudes[17,21,25]. Second, marker kinetics are strongly time-dependent, and sampling schedules can materially alter both the direction and magnitude of observed effects[17,21]. Third, blood marker trajectories do not always map linearly onto perceptual or functional recovery domains[11,17].

These features explain a recurrent pattern in tart cherry studies: soreness or function may improve with a limited biochemical shift, or selective biochemical movement may occur without a clear transfer to applied performance outcomes[10-13,16,17]. Instead of being reduced to a simplistic efficacy/non-efficacy dichotomy, such findings should reflect the layered nature of recovery biology and the methodological diversity in the evidence base[16,17,21].

Therefore, biochemical data should be retained as an important evidence layer and used as complementary rather than standalone criteria in practice. In high-performance settings, a hybrid interpretation model is often the most realistic: periodic biochemical checks for the mechanistic context combined with routine perceptual, neuromuscular, and training quality metrics for day-to-day decisions[5,15,17,26].

Sources of Heterogeneity Across Studies

The observed inconsistency across studies is better interpreted as heterogeneity-driven uncertainty rather than as direct evidence of ineffectiveness[12,16]. Variabilities in product composition and reporting quality have also been reported in prior reviews[10,13]. First, product heterogeneity is substantial; anthocyanin/polyphenol content, concentration factors, processing/storage conditions, and reporting quality vary considerably[10,12-14]. Second, protocol heterogeneity is important. Previous reviews have noted substantial differences in preloading duration, intake frequency, and post-exercise continuation across studies[10,12,16]. These timing differences may influence whether supplementation overlaps with the period during which the inflammatory and recovery-related responses are most pronounced[17]. Third, participant and exercise model differences further increase variability. Reviews have highlighted that outcomes may differ according

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to training status and exercise type[4,11,12]. This is also reflected in the primary literature, which includes endurance-based designs[27], intermittent exercise models[28], eccentric-damage paradigms[30], and trials reporting null findings in different populations and formats[31-33]. Fourth, endpoint and assessment-time mismatches complicate synthesis because the perceptual, neuromuscular, and biochemical domains reflect different layers and time courses of recovery[11,17]. Future progress requires stronger comparability through rigorous composition reporting, harmonized core outcomes, standardized assessment windows, and ecologically valid protocols that reflect real competition schedules[12-14].

Null and Inconsistent Findings: Interpreting Limits to Efficacy

Although numerous studies have reported favorable changes in selected recovery-related outcomes, a meaningful subset of controlled trials demonstrated null or inconsistent effects. These findings warrant analytical depth rather than brief contextualization, as they may reflect genuine limits to efficacy rather than merely methodological artifacts. In some investigations, tart cherry supplementation failed to significantly attenuate strength loss, reduce biomarkers of muscle damage, or improve perceptual recovery, despite biologically plausible mechanisms. Such outcomes suggest that these effects are not universal across all exercise models, athlete populations, or operational contexts.

Several explanations merit consideration. First, population characteristics may have influenced responsiveness. In well-trained athletes with lower baseline inflammatory responses or rapid endogenous recovery capacity, ceiling effects may limit detectable benefits. Second, the magnitude and type of muscle-damaging stimuli varied substantially across protocols. Eccentric-heavy laboratory models, prolonged endurance events, and intermittent high-intensity formats differ in inflammatory burden and neuromuscular disruption. Supplementation effects may depend on whether oxidative and inflammatory signaling reach a threshold where modulation significantly alters recovery kinetics. Third, supplement composition and reporting transparency remain inconsistent. Anthocyanin density, total polyphenol content, processing conditions, and sugar profiles differ across commercially available products, potentially contributing to variable physiological exposure. Fourth, outcome timing may influence interpretation: effects observed at 24 h may not persist at 48-72 h, or biochemical shifts may not translate into measurable performance improvements.

Importantly, null findings may indicate that tart cherry supplementation has context-dependent utility rather than broad-spectrum efficacy. Recognizing these boundaries strengthens applied interpretations. Therefore, a balanced appraisal requires acknowledging that tart cherry may confer modest benefits in specific scenarios while offering limited or negligible advantage in others.

Chronic Antioxidant Supplementation and Training Adaptation: A Conceptual Caution

While tart cherry supplementation is frequently positioned as a recovery-enhancing strategy, an important conceptual consideration concerns the potential for chronic antioxidant exposure to attenuate exercise-induced adaptations. Reactive oxygen species (ROS) generated during exercise are not solely damaging by-products but also act as signaling molecules involved in mitochondrial biogenesis, endogenous antioxidant upregulation, and muscle remodeling[35]. In some contexts, high-dose antioxidant supplementation (e.g., vitamins C and E) has been shown to blunt training-induced improvements in mitochondrial signaling and endurance adaptations, likely through excessive dampening of redox-sensitive pathways[35,36].

Although tart cherry differs mechanistically from isolated antioxidant vitamins, providing a complex polyphenol matrix with anti-inflammatory and vasoregulatory properties, the possibility that sustained, high-frequency supplementation could alter redox signaling dynamics warrants further consideration. Notably, most tart cherry studies employ short-term loading protocols surrounding acute exercise bouts or competitions rather than chronic daily ingestion across extended training blocks[3,8,11]. Therefore, the current evidence base more strongly supports periodized use in proximity to competitions or intensified training phases rather than continuous year-round supplementation.

From a translational standpoint, tart cherry may be most appropriately framed within a recovery-timing architecture, where its use is strategically aligned with congested competition schedules, repeated high-intensity efforts, or return-to-play scenarios characterized by an elevated inflammatory burden. Conversely, during foundational training phases emphasizing long-term adaptation, caution may be warranted if antioxidant exposure suppresses endogenous signaling cascades. However, direct evidence demonstrating adaptation blunting, specifically with tart cherry, remains limited, and further longitudinal training studies are required to clarify the dose-response relationships and chronic adaptation outcomes. Accordingly, practitioners should interpret tart cherry as a context-dependent intervention, with its greatest value likely emerging in acute recovery windows rather than continuous adaptation-focused training periods or as a universal daily recovery solution.

Other polyphenol-rich foods such as pomegranate, beetroot, and blueberry have also been investigated as recovery-supporting strategies in sport. While these foods share antioxidant and anti-inflammatory properties, tart cherry supplementation currently has one of the more consistent evidence bases in controlled exercise-recovery trials, particularly in relation to muscle soreness and selected functional recovery outcomes. However, direct comparative trials between these polyphenol sources are limited.

Translating Evidence into Sports Nutrition Practice

In applied settings, tart cherry juice should be positioned as an adjunct rather than a replacement for foundational recovery determinants such as adequate energy intake, carbohydrate/protein distribution, hydration, and sleep[7,22-24]. The most defensible implementation context is when recovery bottlenecks are likely (e.g., congested fixtures, short

turnarounds, heavy travel, or clustered high-intensity sessions)[5,6,15]. Structured short trials under comparable loading conditions are generally preferred for automatic, long-term habitual use[11,12,16]. The scenario-based, practice-oriented tart cherry juice protocol is presented in Table 2.

A range of dosing strategies has been used in controlled trials; however, substantial variability exists across product formats and dosing architectures[16], with inconsistent reporting of anthocyanin content across studies[10,13]. Most evidence has been derived from juice or concentrate preparations administered over several days, before and after an exercise bout[1-3,11,29]. Instead of representing interchangeable prescriptions, these values should be interpreted as study-based exposure patterns in specific experimental contexts.

Importantly, dose equivalence across juice, concentrate, and powder/capsule formats cannot be assumed when anthocyanin and total polyphenol content are not completely reported[10,12,13]. This concern is particularly relevant as newer powdered formulations are now being studied alongside juice and concentrate products[22]. Reported anthocyanin exposure varies widely across studies, reflecting differences in processing, concentration, storage conditions, and reporting standards[12-14]. Accordingly, practitioners should avoid direct volume-to-milligram conversion without verifying composition data.

From an applied perspective, implementation is most

Table 2. Practice-oriented tart cherry supplementation protocols by scenario

Scenario	Primary objective	Suggested protocol	Start/ duration	Monitoring priorities (24–72 h)	Continue/adjust/ stop criteria	Practical notes
Congested fixtures (2+ matches/ week)	Maintain readiness and reduce soreness burden between short turnarounds	Option A: 30 mL Montmorency concentrate, 2/day [2,3,28,29] Option B: 300–710 mL/ day tart cherry juice[1,8,27,32]	Start 2–4 days before first fixture; continue through congested block	DOMS (site-specific + global), CMJ/ isometric trend, session RPE, completion of planned sets, GI tolerance	Continue if soreness and readiness improve with stable training quality; adjust dose/form/timing if GI issues or poor adherence; stop if no functional transfer	Account for calories from juice/concentrate in total plan; prioritize portability on travel days
Heavy travel + time-zone stress	Protect next-session quality when sleep and routine are disrupted	Same as above; prioritize portable trial-based options (especially concentrate) when logistics are limiting	Begin 2–3 days pre-travel; continue until first high-quality post-travel session is completed	Sleep quantity/ quality, DOMS, readiness score, training completion, GI comfort	Continue if next-session completion and technical quality are preserved; reassess if tolerance or compliance declines	Integrate with hydration, carbohydrate timing, and sleep strategy
Eccentric-heavy microcycle (strength/ power phase)	Attenuate soreness and accelerate strength/power restoration	30 mL Montmorency concentrate, 2/ day, or trial-based tart cherry juice alternative	Start 2–3 days pre-load; continue 2–4 days post-load	DOMS at trained muscle groups, force/power proxy (CMJ or isometric), perceived recovery	Continue when baseline restoration is faster and training output is preserved; adjust if no benefit after 1–2 comparable trials	Do not replace core recovery pillars (energy, protein/ carbohydrate distribution, sleep)
Tournament week (multiple high-intensity exposures)	Preserve repeated performance and athlete availability	30 mL Montmorency concentrate, 2/ day, or tart cherry juice option aligned with trial-based dosing; keep timing consistent each day	Start 3–4 days pre-tournament; continue through final event day	Morning wellness, DOMS, neuromuscular quick test, session execution quality, availability	Continue if availability and execution improve; adjust architecture (timing/ frequency/form) if signals are mixed	Use team baseline protocol plus athlete-specific refinement
Body-composition-sensitive phase	Recovery support with minimal caloric burden	Prefer lower-calorie tart cherry formats supported by randomized trial evidence, especially concentrate-based protocols	Short, targeted blocks only (highest recovery-pressure windows)	DOMS, readiness, output quality, GI tolerance, body-mass trend	Continue only if recovery gains are evident without compromising composition targets	Do not assume equivalence between juice and concentrate products; verify anthocyanin/ polyphenol composition when available
Off-season/ low recovery pressure	Avoid unnecessary habitual supplementation	No routine use; consider only during planned overload blocks	Case-by-case short trial	Same multidomain checks, with emphasis on training-quality transfer	Discontinue if no clear added value over standard nutrition/ recovery practices	Periodize use by need, not habit

Abbreviations: CMJ, countermovement jump; DOMS, delayed-onset muscle soreness; GI, gastrointestinal; RPE, rating of perceived exertion

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defensible when anchored to a defined recovery objective (e.g., a congested competition schedule or intensified microcycle) rather than habitual daily ingestion[5,6,15]. Where feasible, alignment with trial-based composition characteristics and short-term response monitoring is preferable to fixed numeric prescription[11,12,16]. Given the current heterogeneity and limited dose-response evidence, cautious interpretation and context-specific adjustments are warranted. Despite the variability in dosing architecture, it is important to recognize that not all controlled trials have demonstrated favorable recovery outcomes.

Not all controlled trials have reported recovery benefits with tart cherry supplementation. In non-resistance-trained men, a 5-day tart cherry juice protocol (2 × 250 mL/day) did not significantly enhance recovery after muscle-damaging exercise[32]. Similarly, an 8-day intervention using concentrated tart cherry capsules (1,000 mg/day) in recreationally active young women showed no significant effect on soreness, peak torque, muscular power, or muscle activation following intense leg-extensor exercise[33]. In addition, Squires et al. tested Vistula tart cherry extract (2 × 5.1 g/day for 4 days post-exercise) and found no superiority over the placebo after a maximal eccentric elbow-flexor protocol[34]. These null findings should be interpreted as evidence of potential limits to efficacy rather than being dismissed as simple methodological artifacts. The potential moderators included participant characteristics, formulation, dose equivalence, and exercise model[12,16,31-33]. Sex differences may represent another important but insufficiently studied source of heterogeneity. Biological differences in endocrine profile, inflammatory response, and recovery kinetics may alter the magnitude or timing of the response to tart cherry supplementation. However, female-only trials remain scarce, and the current evidence base has not been sufficiently developed to determine whether the efficacy differs meaningfully by sex. As noted by Brown et al.[11], future studies should address female representation and sex-specific response patterns to improve translational confidence.

Continuation should be response-guided. If soreness burden decreases, neuromuscular readiness improves, training quality is better preserved, and adherence/tolerability remain acceptable, ongoing use may be justified for such contexts[5,15,26]. If the benefits are limited or the tolerability is poor, protocol reassessment (timing/frequency/format/duration) is warranted[11,12,16]. At the team level, a shared baseline framework with athlete-specific refinement is typically the most realistic[5,15].

Monitoring Framework for Applied Implementation

Practical value should be judged by measurable recovery and operational outcomes, and not by supplementation status alone[5,15,26]. A feasible monitoring window is 24-72 h post-load, when perceptual and functional changes are often most visible[2,3,9,15].

Thus, a multidomain framework is recommended. In the perceptual domain, site-specific DOMS should be tracked alongside global recovery perception, because this pairing improves sensitivity to both local discomfort and whole-body readiness[5,15]. In the neuromuscular domain, repeated low-burden assessments, such as countermovement jumps or isometric indicators, should be used to monitor the recovery trajectory and return to baseline capacity[5,15,26]. In the training quality domain, the session rating of perceived exertion (RPE), completion of planned sets/repetitions, and technical session quality should be jointly reviewed to determine whether recovery translates into executable training output[5,15,26]. In the tolerance/adherence domain, gastrointestinal comfort, palatability, and practical compliance must be monitored because poor tolerability can negate the physiological potential[11,12,22]. Finally, in the operational domain, next-session completion rate and weekly athlete availability should be tracked because they most directly reflect the real-world utility in competitive systems[5,6,15].

This integrated model enables high-quality decision-making, even when biochemical shifts are small or inconsistent[15,17,26]. If session completion and athlete availability improve with acceptable tolerability, the practical value may be considered meaningful. Conversely, isolated marker shifts without functional transfer should prompt protocol reassessment[11,17]. This framework should be interpreted as a hypothesis-generating, expert-informed model pending formal empirical validation. However, it has not yet been prospectively tested as an integrated field-implementation model.

Limitations and Evidence Considerations

This synthesis should be interpreted in light of several evidence base considerations. Although a structured search strategy and formal risk-of-bias appraisal were applied, this study remains a narrative integration rather than a formal systematic meta-analysis. Accordingly, study selection and interpretive emphasis may be influenced by heterogeneity in available protocols, outcome domains, and reporting standards. Substantial between-study variability in anthocyanin/polyphenol content, supplement formulation, dosing architecture, and assessment timing complicates direct comparison and limits certainty regarding dose-response relationships.

Beyond methodological heterogeneity, the characteristics of the study design across the evidence base warrant closer attention. Most randomized trials have relatively small sample sizes and frequently employ crossover designs, which may enhance sensitivity to acute effects but limit generalizability to longer training periods. Although blinding is commonly reported, the detailed reporting of allocation concealment and pre-registration remains inconsistent. In addition, incomplete disclosure of anthocyanin and total polyphenol content complicates replication and interpretation of dose equivalence. While structured appraisal tools (RoB 2 for randomized trials and AMSTAR 2 for reviews) were incorporated, the predominance of short-duration interventions and heterogeneous outcome timing reduced the certainty regarding long-term adaptation effects and broader population applicability.

Another consideration concerns potential funding- and sponsorship-related influences within the tart cherry lit-

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erature. A proportion of trials reported industry funding, product provision, or support from organizations affiliated with tart cherry production or marketing. Although industry involvement does not inherently invalidate these findings, sponsorship bias and selective publication remain recognized risks in applied nutrition research. In a field characterized by modest sample sizes and variable effect magnitudes, even subtle reporting asymmetries may influence the overall interpretive tone. Accordingly, funding sources and declared conflicts of interest should be considered when translating the findings into applied recommendations.

Future research would benefit from pre-registered protocols, transparent and standardized reporting of anthocyanin and total polyphenol content, harmonized core outcome sets with standardized sampling windows, independent replication across diverse athletic populations, and valid competition-based designs. Such refinements would improve confidence in distinguishing true physiological effects from context-dependent variability or potential sponsorship-related influence.

CONCLUSION

Current evidence suggests that tart cherry juice is a biologically plausible, context-dependent adjunct for recovery following EIMD. The most repeatable favorable signal appears in DOMS and perceptual recovery, whereas neuromuscular effects are potentially meaningful but condition-dependent. Biochemical outcomes remain heterogeneous owing to variability in individual responses, marker kinetics, and study design.

Accordingly, tart cherry juice is best used as a purpose-driven supplement during periods of high recovery pressure rather than as a universal fixed prescription. The strongest applied approach combines scenario-based use with response-guided, multidomain monitoring that includes perceptual, neuromuscular, training-quality, adherence/tolerability, and athlete-availability outcomes. Future research should prioritize composition standardization, harmonized core outcomes, standardized sampling windows, and valid competition-based designs to improve the precision and transferability of practical recommendations.

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