AIS SPORTS SUPPLEMENT FRAMEWORK
QUININE (QUININE HYDROCHLORIDE DIHYDRATE)

What is it?

> Quinine is a bitter alkaloid sourced from the bark of the cinchona tree[1] and has a long history of use in traditional medicine such as a treatment for malaria[2], where doses of 1g of quinine sulphate were administered before the acute phase.[3]

> Quinine carries a strong bitter taste[4] and is used in tonic water as a flavouring agent.[1] Its concentration in commercial beverages varies greatly and such products typically lack nutritional information detailing the amount of quinine used. The concentration of quinine in tonic water is much lower than that used for medical purposes.

> Quinine is one of the latest emerging acute nutritional strategies that purportedly activate brain areas to reduce perception of effort and subsequent pacing decisions, in both research and practical settings.[5]

> Ingestion of Quinine activates the bitter taste receptors in the oral cavity and upper gastrointestinal tract to increase corticomotor excitability and stimulate neural excitability.[4] Changes in the autonomic nervous system (ANS)[6,7] provide a potential mechanism to enhance performance in high effort, short duration activities.

> Unlike the case for carbohydrate mouth rinsing, the quinine solution needs to be swallowed for it to prove effective[4] and to ensure that it has contact with specific receptors that are concentrated in the back of the mouth and throat.

> Benefits of quinine ingestion as a sensory-driven tastant include increased 30 second cycling sprint performance by 2.5-4%[8] and increased cycling performance (~6%) during initial stages of a 3 to 4-minute cycling effort.[9]

> Since the effects of quinine ingestion are seen immediately after the ingestion of quinine, the ergogenic effect has been attributed to central activation by afferent taste.

> To date, studies that have reported benefits of quinine ingestion have involved exercise protocols undertaken on cycle ergometers. It is unclear if this translates to real world cycling (e.g. track cycling) and whether other sprint events in running or swimming would benefit from pre-event quinine ingestion.

> It is unclear whether other factors might inhibit or diminish sensory-driven pathways when ingesting quinine. For example, bitter tasting medications are often masked by manipulations involving salt.[10] Therefore, it might be possible to counter-act an unpleasant and persistent bitter taste after the event by ingesting a salty snack. However, whether salt intake prior to or around the pre-event quinine ingestion interferes with any ergogenic effect is unknown.

> It is also relevant to explore ways to amplify sensitivity to the bitter taste prior to ingesting quinine to magnify performance benefits without needing to increase the actual dose.

What does it look like?

The manufacturer's guidelines should be followed in regards to the shelf-life of the quinine powder (Quinine Hydrochloride Dihydrate). Once the solution is prepared it should be consumed as soon as possible given the lack of information about the shelf-life and biological effectiveness.

How and when do I use it?

> A single dose of quinine solution is prepared by mixing 0.02 g of Quinine Hydrochloride Dihydrate in 25 ml of deionised water (or 0.08 g per 100ml of deionised water). Such a solution is considered safe to use. However, quinine powder (Quinine Hydrochloride Dihydrate) is considered hazardous and requires careful handling.

> It is necessary to swirl the quinine solution in the mouth and then swallow it to achieve a beneficial effect.[11]

> Such a protocol (10-20 seconds prior to the sprint) has been found to improve a maximal 30 second cycling effort[8] and the initial 80 seconds of a 3 to 4-minute cycling time-trial.[9]

> However, quinine ingestion during the last 90 second of a 4-minute maximal cycling effort has failed to improve performance.[12]

> Ingesting the directed single dose of quinine solution triggers an extremely bitter sensation in the mouth, which can be counteracted, post-event and after benefitting from the ergogenic effect of the tastant, by ingesting a salty snack (e.g. Salt and Balsamic vinegar flavoured rice cakes) or equivalent.

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Are there any concerns or considerations?

Limited evidence for dose-response

> No adverse effects have been reported when quinine is used in low doses (0.02 g of quinine in a 25 ml solution) prior or during exercise, and a single dose of quinine solution as described above is considered safe for use. It is unclear if concentrations higher than 2mM of quinine would trigger a higher sensory-driven response for even greater performance benefits – or, in contrast to this, induce detrimental effects.

> Currently, there is insufficient evidence to consider individual responsiveness to quinine ingestion in the sporting setting. However, ingestion of strong-tasting nutrients alongside or prior to quinine ingestion could interfere with its performance effects if it counteracts the bitter taste or sensory response triggered.

Careful handling required

> Quinine powder (Quinine Hydrochloride Dihydrate, S1125, Sigma-Aldrich Pty Ltd, Australia) is considered a hazardous chemical and requires careful handling when preparing the solution.

> Although not classed as a dangerous chemical, inappropriate handling or accidental inhaling of quinine powder can cause acute oral toxicity, impaired respiration and skin sensitisation.

Evidence for benefits still lacks certainty

Benefits might be specific to certain scenarios and short-term duration of effort. Further research is needed before more information can be provided around specific protocols, including targeted sprint events, potential uses in training and different modes of ingestion (e.g. gels or solid forms) that might be more practical to achieve in competition scenarios.

Where can I find more information?

Supplement safety information and batch tested product list

www.sportintegrity.gov.au/what-we-do/anti-doping/supplements-sport

References

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The Australian Institute of Sport (AIS) Supplement Framework is an initiative of the Australian High Performance Sport System. The AIS acknowledges the support of members of the National Institute Network (NIN) and National Sporting Organisations (NSO) and their staff in delivering content expertise. This information is intended to help athletes, coaches and scientists make evidence-based decisions about the use of supplements and sports foods. Before engaging in supplement use, we recommend that each individual refer to the specific supplement policies of their sporting organisation, sports institute or parent body, and seek appropriate professional advice from an accredited sports dietitian (**www.sportsdietitians.com.au**).

Athletes should be aware that the use of supplements may have doping implications. Athletes are reminded that they are responsible for all substances that enter their body under the 'strict liability' rules of the World Anti-Doping Code. Some supplements are riskier than others. The Sport Integrity Australia (SIA) app is a useful resource to help mitigate the risk of inadvertent doping by helping to identify supplements that have been batch-tested. The SIA App provides a list of more than 11,000 batch-tested products. We recommend that all athletes consult the educational resources of SIA regarding the risks associated with supplements and sports foods.. While batch-tested products have the lowest risk of a product containing prohibited substances, they cannot offer you a guarantee that they are not contaminated (**www.sportintegrity.gov.au/what-we-do/supplements-sport**).

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