



Perceptual Cooling for Athletic Performance in the Heat: it's Absolutely Menthol!

<https://youtu.be/XMXm1G8kTz4>

[Dr Martin Barwood](#), Leeds Trinity University, West Yorkshire, UK

Athletic Performance in the Heat

Athletic performance is reduced in hot environments compared to cool and temperate conditions (Tucker et al., 2004). Elite level athletes and teams are frequently required to undertake their training and competitive activities in hot conditions. For example, the rescheduled Olympic Games in 2021 will be held in Tokyo where temperatures have been shown to peak at ~31.5°C with a relative humidity (RH) of ~60% (Gerrett et al., 2019). Such conditions are expected to limit athletic performance particularly in endurance events lasting >2.5 minutes (Barwood et al., 2020). Despite detailed preparations, experienced athletes are still prone to catastrophe when performing in such extreme conditions. In the recent IAAF World Athletic Championships Women's marathon event in 2019 in Qatar (peak temperature 32.7°C, 73% RH) 28 of the 68 strong competitive field (41%) failed to complete the race primarily due to premature exhaustion and heat related illnesses. The forthcoming World Cup football in 2022 also in Qatar, may experience similar problems unless the environmental heat strain can be mitigated. As such, cooling interventions to improve perception and performance are of great interest to athletes, scientists and practitioners. In recent years, there has been a great deal of interest in the additive benefit of including menthol to cooling interventions.

Menthol is a naturally occurring cyclic terpene alcohol that is extracted from plants of the Mentha genus e.g. peppermint and corn mint [Galeotti et al., 2002]. Presenting in eight forms, the (-)-isomer is responsible for menthol's characteristically fresh aroma, taste and cooling sensation when applied to mucous membranes or the skin, with its effects inversely proportional to the thickness of the membrane to which it is applied [Stevens & Best., 2018; Watson et al., 1978].

Perceptual Cooling: How?

Menthol chemically activates thermally sensitive receptors (thermoreceptors) mirroring real temperature change within the range of 8 to 28°C (Patel et al., 2007). The receptor has been identified as the membrane bound ion channel transient receptor potential melastatin 8 [TRPM-8; Macpherson et al., 2006]. Stimulation of these receptors during periods of heat stress has consistently been shown to improve thermal comfort and decrease thermal sensation (Stevens and Best, 2018). These receptors are known to exist in the skin, oral cavity and along the gastro-intestinal (GI) tract and have been targeted to improve perception and performance during exercise in the heat (see Table below for example studies).

Example Study	Application Site	Concentration	Effects
Barwood et al [2019]	Skin: Torso & Arms	0.2% sprayed menthol repeatedly applied to the torso	Improved perception ↑ TTE performance
Flood et al [2017]	Mouth Rinsing	0.01% 25 mL mouth rinses repeated throughout exercise	Improved perception (cooler) ↑ performance at fixed RPE
Riera et al [2014]	GI Tract	0.5% menthol in neutral, cold and ice-slush beverages	↑ 20 km TT performance

Recent Systematic and Consensus Evidence

The evidence for enhanced perception and performance of menthol-based application and mouth rinsing has been reviewed (see Jeffries & Waldron, 2019) and, in addition, the emerging evidence of efficacy in ingestion studies (see Stevens and Best, 2018). More recently the evidence to date has been considered by consensus with a view to providing guidance for safe use of menthol-based interventions for athletes, practitioners and performers in the upcoming Olympic Games (see Barwood et al., 2020) which will be the focal topic of this vICEE talk.



Questions

1. From a practical perspective, which Olympic Sports are most amenable to menthol-based cooling interventions?
2. Are there any health-related risks associated with preparing and utilising menthol-based interventions during exercise in the heat?
3. Are menthol-based interventions widespread in elite and recreational sport?
4. Are menthol-based interventions within the “spirit and ethos” Olympic Sport in accordance with WADA guidelines?

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