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Original Research

Commercial Asian Herbal Cooling or Heat-Clearing Tea Products in Singapore: An Analysis of Compositions and Claims

Abstract

Traditionally, cooling teas are herbal preparations brewed from cooling herbs. This study examined information on delivery form, selling platform, pricing, compositions (herbal and non-herbal), and claims (health and non-health) of 65 commercial cooling teas in Singapore and whether their herbal compositions were related to their health claims.

The required information was extracted from the product labels.

The 65 studied products were 100% plant-based and manufactured in Asian countries. Most retailed in teabag form (44.6%). While none of the cooling tea products studied contained added colourings, flavourings or preservatives, sweeteners were added to 40%; sugar was the most prevalent sweetener (21.5%). Herbal cooling tea is traditionally consumed to prevent or alleviate flu or cold symptoms and may explain why immunity and respiratory health boosting benefits were among the common health claims stated on commercial cooling tea products. The top three health claim domains were immunity (42%), digestive (40%), and respiratory (38%). Non-health claims were stated on the labels of 13.9% of the surveyed products. Preservative-free (9.2%), caffeine-free (7.7%), and artificial colouring-free (4.6%) were the more prevalent non-health claims. Of the 99 herbs used in Asian cooling teas, the three most prevalent were *Flos Chrysanthemum morifolium* (50.8%), *Flos Lonicera japonica* (30.8%) and *Prunella vulgaris* (20.0%). These three herbs are reputed to contribute to immune, digestive and respiratory health, potentially due to their antioxidant and anti-inflammatory properties. The concept of cooling in Traditional Chinese Medicine may relate to the restoration of oxidative balance and alleviation of inflammation.

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Introduction

The concept of warming and cooling is based on the Chinese philosophy of yin (cooling) and yang (heaty) [1]. The terms heaty and cooling act as a classification system to describe symptoms and characteristics of certain foods and the effects they have on the human body [2]. More than 2,000 years of detailed observation in Traditional Chinese Medicine (TCM) has been used to develop this classification system [2]. Heaty foods refer to foods with an ability to give warmth, improve circulation, dispel cold, and stimulate the body [3]. When taken in excess, heaty foods are believed to cause heatiness, resulting in a fever, sore throat, mouth ulcers, acne, excessive thirst, and skin irritability [3]. Heaty foods are usually high in calories and subjected to high cooking temperatures, such as baking and deep-frying [3]. They include chocolate, red meat and all baked and deep-fried foods [3]. Cooling foods, in contrast, trigger conditions associated with coolness [3]. After eating a diet high in cooling foods, a person may become intolerant to cold, pale in complexion, and experience fatigue with sore joints and muscles [3]. Cooling foods are typically lower in calories and subjected to little or no heat in preparation [3]. Fresh salads, mangosteens and watermelons are some examples of cooling foods [3].

Like cooling foods, cooling teas or heat-clearing teas are tea preparations that may eradicate body heatiness [2]. They are popular among consumers living in tropical climates or during summer in temperate climates when the weather is warm and humid – weather that is believed to contribute to body heatiness [3]. Traditionally, cooling teas are herbal preparations brewed cooling herbs. Most of these teas are entirely plant-based. However, little is known about the herbal compositions of commercial herbal cooling teas in Singapore. Ingredients – other than herbs – added in the preparation of these cooling teas are also relatively unknown. Data on the health and non-health related claims of these commercial cooling teas are relatively scarce.

This study examined the information on delivery format, selling platform, pricing, compositions (herbal and non-herbal), and claims (health and non-health) of 65 commercial cooling teas in Singapore. It also examined possible relations between the herbal compositions of these teas and their health claims.

Materials and methods

Data collection

All available cooling teas on the shelves of two major pharmaceutical retail outlets (Guardians and Watson), two major supermarkets (Fairprice and Cold Storage), and two major e-commerce platforms (Lazada and Shopee) in Singapore were included in this study. Product data, including country of manufacture, retail format, and retail price, herbal and non-herbal compositions, claims (health and non-health) were recorded by trained research personnel. Non-herbal composition refers to ingredients that are not herbal by nature and includes sweeteners and additives (colourings, flavourings, and preservatives). This information should be printed on the item's packaging as regulated by the Health Science Authority, Singapore. The presence of added colourings, flavourings, preservatives, and sweeteners in each item was also noted from its product label. The daily cost was computed by dividing the product's price by the number of daily doses, which was calculated as the ratio of the delivery units in the product to the number of delivery units recommended to be taken daily. The health claims were categorized into their respective body system domains.

Data analyses

Data were statistically described and analyzed using Microsoft Excel (version 2103, April 2021).

Results

Product factors

Sixty-five products were included in this study. All the studied products were 100% plant-based. The products were manufactured or sourced from Asian countries, including China (46.3%), Singapore (28.3%), Malaysia (22.4%), and Taiwan (3.0%). Of the surveyed products, the majority (85.07%) was purchased online, while 14.93% were sold in physical retail stores. The retail mean (±SD) price was S$19.55±25.43, ranging from S$2.50 to S$161.26. The mean (±SD) serving cost was S$5.53±9.87, ranging from S$0.06 to S$40.90. The products were retailed either as teabags (44.5%), loose herbs (33%), ready-to-drink (18.5%), or powder (4%).

Herbal compositions

Ninety-nine types of herbs were used in the composition of the 65 Asian cooling teas studied (**see Table 1**). *Flos Chrysanthemum morifolium* (*C. morifolium*, 50.8%), *Flos Lonicera japonica* (*L. japonica*, 30.8%), *Prunella vulgaris* (*P. vulgaris*, 20.0%), *Glycyrrhiza uralensis* and wolfberry (15.4%), *Siraitia grosvenorii* (13.8%), *Folium mori* (12.3%), cassia seed, *Herba Lophateri*, *Rhizome imperatae*, *Mentha arvensis*, and osmanthus (9.2%) were the most common herbs used in the surveyed Asian cooling teas (**Fig. 1**).

Table 1 Herbs (listed alphabetically) used in cooling teas commercially available in Singapore (n=65).

Agastache rugosa	*Flos Sophora japonica*	*Perilla frutescens*
Angelica anomala	*Folium isatidis*	*Perotis indica*
Areca catechu	*Folium Mori*	*Phragmites communis*
Atractylodes lancea	*Forsythia suspensa*	*Platycodon grandiflorus*
Baked Barley	*Fructus viticis*	*Poncirus trifoliata*
Bamboo Cane	*Gardenia jasminoides*	*Potentilla Discolour*
Bamboo Leaves	*Gentiana scabra*	*Prunella vulgaris*
Barely Tea	Ginger	*Radix Arnebiae*
Barley	Glycyrrhiza uralensis	*Radix isatidis*
Black Prune	Hawthorn	*Radix Ophiopogonis*
Bupleurum chinense	Hemp Seed	*Radix Panax Ginseng*
Burdock Root	*Herba abri*	*Radix Panax Quinquefolium*
Camellia sinensis	*Herba hedyotidis diffusae*	*Radix Puerariae*
Cassia Leaf	*Herba lophateri*	*Radix rehmanniae*
Cassia Seed	*Herba scrutellariae Barbatae*	Red Dates
Chamomile	*Ilex rotunda*	Red Root
Platostoma palustre	*Isodon serra*	*Rehmannia glutinosa*

Cimicifuga heracleifolia	Jasmine	*Rheum officinale*
Cleistocalyx operculatus	*Juncus effusus*	*Rhizome imperatae*
Clerodendron fragrans vent	*Ledebouriella divaricata*	Roselle
Corn Silk	*Ligusticum wallichii*	Rough-Leaved Holly
Cornu saigae tataricae	Lily Bulb	*Saussurea lappa*
Dandelion	Loquat Leaf	*Scaphium affine*
Dark Plum Fruit	Lotus Leaf	*Schizonepeta tenuifolia*
Dried Kumquat	*Mentha arvensis*	*Scrophularia ningpoensis*
Dried Rose	*Microcos paniculata*	*Spilanthes acmella*
Elsholtzia splendens	Mojette beans	*Syzygium jambos*
Eriobotrya japonica	Monk Fruit/ *Siraitia grosvenorii*	Tangerine Peel
Fish Mint	Mulberry	Tangerine Skin Extract
Flos Bombax ceiba	*Notopterygium incisum*	White Crane Flower
Flos Chrysanthemum morifolium	Orange Peel	Wolberry
Flos Lonicera japonica	Osmanthus	Wolfiporia
Flos Plumeria rubra	Peppermint	Yellow Tartary Leaf

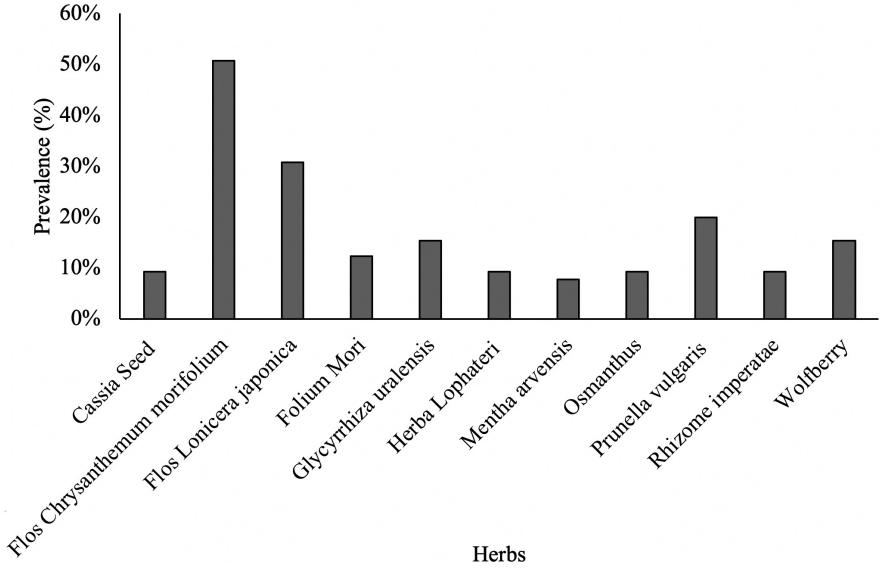

Figure 1 Prevalence of ten most common herbs used in the cooling tea commercially available in Singapore (n=65)

Colourings, flavourings, sweeteners, and preservatives

None of the cooling teas studied contained colourings, flavourings or preservatives. However, 40% of the studied cooling tea products had added sweeteners. Sweeteners included honey (6.2%), *Glycyrrhiza uralensis* (liquorice, 15.4%), *Siraitia grosvenorii* (monk fruit, 13.9%), sugar (21.5%) and sugar cane (1.5%). No other sweetener was used. Sugar was added to 7.7% of the studied products with liquorice or monk fruit. Products with monk fruit or liquorice were also sweetened with sugar (6.15%), or honey (1.54%).

Health and non-health claims

All surveyed products stated health claims. The indicated health claims were categorized into sixteen categories: cardiovascular, digestive, endocrine, eye, homeostasis, immunity, inflammation, lymphatic, metabolism, neurology, oral, pregnancy, respiratory, musculoskeletal, skin and ageing and urinary (**Fig. 2**). Immunity (42.0%), digestive (40.0%), respiratory (38%), endocrine (26.0%), and neurology (23.0%) health were the top five health claim domains stated on the surveyed products (**Fig. 2**).

Non-health claims were stated on the labels of 13.9% of the surveyed products. Eleven non-health claims were noted: 100% natural, caffeine-free, cholesterol-free, healthier choice, no additives, no artificial colouring, no flavouring, preservative-free, safe for pregnant and nursing mums, sugar-free, suitable for vegetarians (**Fig. 3**). Preservative-free (9.2%), caffeine-free (7.7%), and no artificial colouring (4.6%) were the more prevalent claims (**Fig. 3**). Singapore Healthier Choice Symbols were listed on 3.1% of the products (**Fig. 3**).

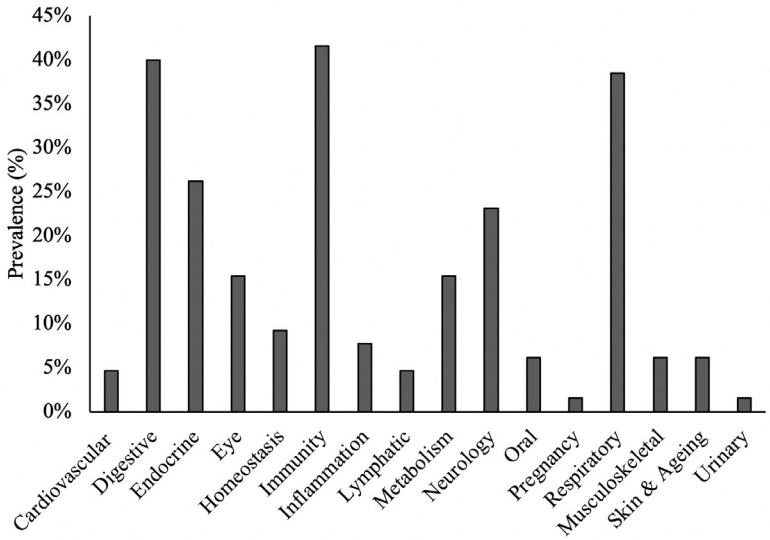

Figure 2 Prevalence of health claims listed on the labels of Asian cooling tea products commercially available in Singapore (n=65)

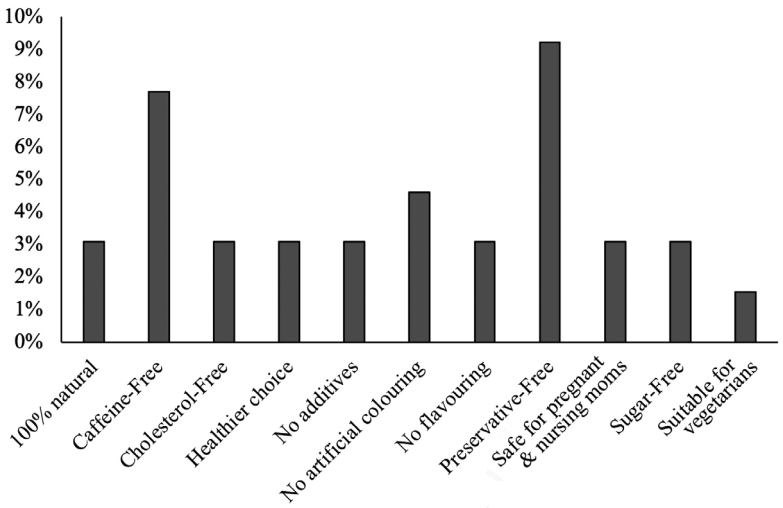

Figure 3 Prevalence of non-health claims listed on the labels of Asian cooling tea products commercially available in Singapore (n=65)

Discussion

Cultural importance of cooling teas

Asian cooling teas are popular in Asian culture and are entirely manufactured in Asian countries. They are now less commonly available in physical retail stores compared to online sources. This may be attributed to the declining number of local Chinese medicine stores as well as to the booming e-commerce trade [4]. Based on the computed mean serving cost, local consumers were willing to spend the equivalent average cost of a cup of coffee, tea or bubble tea on these Asian cooling teas. Asian cooling tea was most commonly retailed as teabags, followed by loose herbs. These results highlighted the popular brewing culture of Asia [5]. Ready-to-drink form is also popular as it offers convenience to consumers [6].

Analysis of antioxidant and anti-inflammatory properties of cooling teas

C. morifolium, *L. japonica*, and *P. vulgaris* were the top three prevalent herbs used in the Asian cooling teas. *C. morifolium* was the most prevalently used herb in the studied commercial Asian cooling teas. Caffeoylquinic acids, flavonoids and carotenoids were reported to be the main bioactive components of *Flos C. morifolium* [7]. Hot-water extraction of *C. morifolium* tea showed that most flavonoids (apigenin, hesperetin, kaempferol, quercetin, and rutin) and caffeoylquinic acids (caffeic and chlorogenic acids) dissolved out at 30 minutes [8]. The identified flavonoids contribute to the colour of the chrysanthemum tea [8]. Previous studies have shown that these phenolic compounds have antioxidant and anti-inflammatory properties [9–11]. Recent studies have also provided evidence that these polyphenols exert immunomodulatory effects [12]. Aqueous extract of *C. morifolium* exhibits significant antioxidant activity that is correlated with its phenolic content [13, 14]. *C. morifolium* infusion has been shown to alleviate inflammation by reducing lipopolysaccharide-induced nitric oxide production and the expression of inducible nitric oxide synthase, tumour necrosis factor-α, interleukin-1β, and interleukin-6 mRNA *in vitro* [15]. Zhang *et al* (2009) attributed the observed anti-inflammatory effects to the phenolic contents of *C. morifolium* [16]. The current limited scientific literature links the contribution of the phenolics in *C. morifolium* to its immunity boosting properties via antioxidant and anti-inflammatory properties. *C. morifolium* also contains vitamins A, C, magnesium, calcium, and potassium and may therefore also boost the immune system [17, 18]. *C. morifolium* polysaccharides were shown to foster beneficial intestinal flora growth, modulate the balance of intestinal microecology, and restore the immune system [19]. Specific pathogenic bacteria, such as *Enterobacter*, *Enterococcus*, *Clostridium* and *Bacteroids* were significantly inhibited by *C. morifolium*, while commensal probiotics, such as *Lactobacillus* and *Bifidobacterium* were moderately promoted [20]. *C. morifolium* improved lung histopathological injury, reduced the ratio of wet/dry lung weight, and lung index in mice with lipopolysaccharide-induced acute lung injury, possibly through the balance of pro-inflammatory and anti-inflammatory factors, and the inhibition of oxygen free radicals [21]. Tea made from *C. morifolium* contains a substantial amount of B vitamins, such as folic acid, choline, niacin, and riboflavin – micronutrients that aid metabolism and boost neurotransmitter activity [17]. Aqueous extract of *Chrysanthemum indicum Linne* exerted a significant anxiolytic effect on mice, possibly mediated by the GABAA and the 5-HT1A receptor [22]. Chlorogenic acid (20 mg/kg body weight) – a major caffeoylquinic acid of *C. morifolium* – induced a decrease in anxiety-related behaviours in a mouse model of anxiety [23]. Correspondingly, *C. morifolium* may exert a similar anxiolytic effect.

Immunity, digestive, respiratory and neurology benefits of cooling teas

L. japonica has demonstrated significant biological effects on the immunity, digestive, respiratory, and neurology functions. *L. japonica* polysaccharides improved the immune functions and raised the antioxidant activities of immune organs in cyclophosphamide-induced immunosuppressed mice [24]. Its aqueous extract promoted the growth of beneficial bacteria Lactobacillus and inhibited the growth of potential pathogenic bacteria [25, 26]. *L. japonica* affects intestinal immune function by regulating the secretion of intestinal mucosal cytokines [27]. Its extract inhibited the synthesis of interleukin-6 (IL-6) in lipopolysaccharide-stimulated colonic epithelial HT-29 cells *in vitro* and a dextran sodium sulfate-induced ulcerative colitis mouse *in vivo* [27]. Park *et al.* (2012) [26] showed that *L. japonica* inhibited the productions of pro-inflammatory cytokines (tumour necrosis factor-α, interleukin-1β, IL-6, interferon-γ, interleukin-12, and interleukin-17) in dextran sodium sulfate-induced ulcerative colitis mice. Oral administration of *L. japonica* extract at a dosage of 600 mg/kg/d effectively alleviated viral pneumonia, maintained body weight and improved the survival rate of the H1N1-infected mice [28]. The flavonoids fraction of the extract exerted the strongest inhibition *in vitro* against H1N1 virus [28]. Lipopolysaccharide-induced changes in learning and memory in mice were significantly reduced by *L. japonica* polysaccharides by alleviating the detrimental pathological changes in the neurons of the mice [29]. Accumulating evidence suggests that *L. japonica* owes its biological activities to its antioxidant and anti-inflammatory properties, which are mainly attributed to its abundant polyphenols [30] and polysaccharides [31]. *In vitro* studies showed that polysaccharide extracts from *L. japonica* exhibited significant 2,2-diphenyl-1-picrylhydrazylhydrate (DPPH) scavenging activity, 2,2′-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) radical (ABTS+) scavenging activity, hydroxyl radical-scavenging activity, superoxide radical-scavenging activity [30, 31]. *P. vulgaris* extract (0.90 g/kg BW) improved non-specific immune function in mice [32]. Administration of *P. vulgaris* extracts to mdr1a(-/-) mice delayed onset of colitis and reduced severity of mucosal inflammation when compared to control mice [33]. *P. vulgaris* polysaccharide inhibited the activity of the herpes simplex viruses (HSV-1 and HSV-2) *in vitro*, and decreased HSV-1 and HSV-2 virus lesions in the guinea pig model [21]. *P. vulgaris* extract attenuated scopolamine-induced brain senescence in rats by improving behavioural performance and decreasing brain cell damage, which was associated with a significant reduction in acetylcholinesterase activity and augmentation of antioxidant activities [34].

Analysis of non-health related food claims in cooling teas

Consumers are accustomed to cooling tea having an intense dark natural colour and an astringent bitter taste so the use of colourings and flavourings is redundant and counter-productive in terms of consumer acceptance. As the common retail forms of dried herbs and teabags allow the product to stay dry and the tea is commonly consumed immediately after brewing, preservatives are not required to prolong the shelf-life. Nevertheless, given the recent literature on the potential deleterious health effects of artificial additives, it is reassuring that preservatives were not used in this group of traditional products. The deliberate absence of added preservatives and artificial colouring were the most common non-health claims stated on the product labels. It is not a well-known fact that herbal products may contain caffeine either as an additive or from a natural source [35]. Usually, caffeine content is not listed on the labels of herbal or natural products. The Singapore Health Science Authority require risk mitigation

measures to be implemented by the manufacturers of caffeine-containing health products – such as information to advise consumers to limit concurrent use of caffeine-containing products (e.g. tea and coffee) when taking supplement or herbal products containing caffeine – and to indicate the amount of caffeine contained in the products so that consumers are aware of the amount consumed [36]. None of the 65 Asian cooling teas analyzed in this study indicated the amount of caffeine contained in the product. A few claimed to be caffeine-free but is unknown whether the products without the caffeine-free claim contain caffeine or not.

Herbal cooling tea products are usually astringent and bitter to taste [5], possibly due to their high phenolic contents. They are usually made palatable with sugar and other sweeteners [5]. Our results indicated that five different sweeteners were added to commercial herbal cooling tea – sugar, liquorice, monk fruit, honey, and sugar cane. Sugar is a traditional natural sweetener that has been used in food and medicine for centuries [37]. The results of the current study confirmed that sugar remains the most prevalently used sweetener. The studied herbal cooling tea products containing added sugar are classified as sugar-sweetened beverages. Public health concerns on obesity have made sugar and sugar-sweetened beverages less acceptable however [38] and evidence suggests that consumers are actively reducing added sugar in their diet [37]. With this in mind, product manufacturers may need to consider reducing the added sugar content and/or replacement strategies to decrease the amount of sugar in their products [37]. Liquorice is recognized as a sweetener used in food and herbal preparations [39]. Glycyrrhizin, a triterpenoid that is 50 times sweeter than sucrose, accounts for the sweetness of liquorice [40]. Though lower in caloric content than sugar, liquorice is commonly considered a traditional herb, and not a sugar replacement [40]. It has been employed as an alternative sweetener in food and herbal preparations. Recently, however, caution has been raised on the excessive use of liquorice as a sweetener [39]. *S. grosvenorii* (monk fruit) has gained popularity among consumers and food manufacturers as a natural sugar substitute [41]. Monk fruit is 300 times sweeter than sucrose and has lower calorie value and is therefore of value as a natural sugar substitute [42]. Its phytochemical content, including phenolic acids and flavonoids, may offer health benefits in addition to being a sweetener. Scientific evidence is gathering on its potential biological activities, such as antioxidative effects, hypoglycemic response, anti-allergic properties, anti-carcinogenic and anti-tissue damage activities [41]. Liquorice and monk fruit had been employed to replace sugar as a sweetener in commercial herbal cooling tea products, evidenced by the significant proportion of the studied products sweetened with just monk fruit or liquorice.

Based on the prevalence of health claims stated on the herbal cooling tea products, the concept of cooling seems to be related to improving health and wellbeing in the immunity, digestive, and respiratory domains. Coincidentally and traditionally, consumers drank herbal cooling tea to prevent or alleviate flu or cold symptoms arising from upper respiratory tract infections [43] and this may explain why immunity and respiratory health boosting benefits are among the common health claims stated on commercial cooling tea products. Indeed, the top three herbs used in these Asian cooling teas contribute to immunity, digestive, and respiratory health, potentially via the antioxidant and anti-inflammatory mechanisms.

Conclusion

The concept of cooling in TCM may relate to the restoration of oxidative balance and alleviation of inflammation. More studies are

required to elucidate the possible relations between oxidative balance, inflammation status, and TCM's cooling effects.

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