

# Lysozyme in the treatment of non-infectious sore throat

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Sore throat is a common reason for seeking medical help [1]. It can have infectious and non-infectious etiology [2]. The term “sore throat” is usually associated with an infectious agent (bacteria, viruses, and less commonly fungi) [1,3,4]. The terms “throat discomfort”, “throat irritation”, or “functional dysphonia due to the occupational diseases” (which represents voice disorder) are often used in the same sense as non-infectious sore throat [2,3]. It is identified by the exclusion of infectious etiology symptoms accompanied with persistent sore throat symptoms (tingling and scratching sensation in the throat, hoarseness or muffled voice, foreign body sensation in the throat, coughing, and difficulty in swallowing accompanied by pain) [2,5].

Various factors can lead to non-infectious sore throat. The most important are: environmental (exposure to smog and irritants), individual risk factors (smoking, alcohol and excessive caffeine consumption, incorrect technique of using voice, and snoring), existence of other diseases (allergies, hormonal disorders, gastroesophageal refluxes, and anxiety disorders), and the use of some medications [2,6]. Epidemiological studies for non-infectious sore throat are rare. In a study performed on 1326 adults in the USA, it was found that 6.6% of respondents had current voice disorders while lifetime prevalence was 29.9% [6]. Professions more susceptible to non-infectious sore throat have high demands on vocal performance (for example, teachers, singers, sports coaches, receptionists, television and radio presenters, lawyers, touristic tour guides, and politicians) [2,3,7]. In modern societies, about one-third of the working population belongs to occupations in which the voice is the primary tool [8]. Teaching is a high-risk occupation for developing voice disorders. In a study performed

on 2531 adults in the USA, teachers had higher prevalence of lifetime voice disorders (57.7%) as compared to other professions (28.8%) [5]. Voice problems may lead to a lower quality of teaching and a serious personal and emotional burden. This can have detrimental effects on the career of teachers, with negative consequences on pupils and employers [9]. Despite the adverse impact of non-infectious sore throat on professional performance and reduced quality of life, only a small number of teachers is seeking professional medical help [10]. This can be due to a low level of awareness on this topic.

Although exact mechanisms of non-infectious sore throat development vary with etiology, inflammation can be found in the majority of cases [2], with elevated pro-inflammatory cytokines such as interleukin (IL)-6, IL- $\beta$ , and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) [2,11,12].

There has been little systematic assessment of treatments for non-infectious sore throat. The field lacks objective outcomes, with most studies relying on subjective (self-reported) endpoints [2]. Although there is no unique doctrine in the treatment, anti-inflammatory medicines and antiseptics are usually used. Inflammation is the pathophysiological mechanism of both infectious and non-infectious sore throat, so similar anti-inflammatory therapies have beneficial effects in both etiologies [2]. Few studies showed positive effects of non-steroidal anti-inflammatory medicines, paracetamol, and steroids [13]. Various herbal formulations and antiseptic lozenges, sprays, and mouthwashes (with or without the addition of an anesthetic or analgesic) are most commonly used [2,12].

Lysozyme is natural enzymatic with properties that could be beneficial in the treatment of non-infectious sore throat. Different types of lysozymes can be found in nature. They have similar structures and share the ability to hydrolyze bacterial cell wall peptidoglycan [14]. Lysozyme is a significant part of the immune system. In humans, it can be found in body secretions, mucosal surfaces, liver, blood, and immune cells [14]. Human milk is rich in lysozyme, which plays an important role in our immunity from the first days of life [15]. The pharmaceutical industry is mainly using hen egg white lysozyme in products for treatment of certain infectious and inflammatory diseases [16].

Besides its direct antibacterial activity, lysozyme has immunomodulatory and anti-inflammatory effects. Immunomodulatory effects have been demonstrated in cancer patients after chemotherapy, where it improved the recovery of CD4+/CD8+ lymphocyte ratio [17]. One of the proposed mechanisms is through the release of immunomodulatory

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compounds after degradation of bacteria by lysozyme [18]. Anti-inflammatory effects have been shown in several studies. Lysozyme is effective in the treatment of diabetic nephropathy through the inhibition of IL-6 production and reduction of macrophage recruitment during inflammation [19]. In human monocytes, it transcriptionally inhibits the TNF- $\alpha$  and IL-1 $\beta$  pathways [20], and in mouse macrophages stimulated with lipopolysaccharide, it suppresses the production of TNF- $\alpha$  and IL-6 [21]. Lysozyme directly inhibits inflammatory mediators, which are key factors for development of non-infectious sore throat.

## CONCLUSION

Lysozyme, a part of our own immunity, has a great potential in treatment of diseases with inflammatory etiology, including non-infectious sore throat. Clinical studies in this area are warranted. They could offer evidence for safe and effective treatment of this very common but still poorly recognized and treated disorder.

**KEYWORDS:** Lysozyme; non-infectious sore throat; anti-inflammatory; immunity

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