Arabian Journal of Chemistry (2015) xxx, xxx–xxx

King Saud University

Arabian Journal of Chemistry

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REVIEW

Morinda citrifolia (Noni): A comprehensive review on its industrial uses, pharmacological activities, and clinical trials

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Received 9 February 2015; accepted 13 June 2015

KEYWORDS

Noni;
Morinda citrifolia;
Cancer;
Pharmacological;
Food;
Industrial

Abstract Traditional medical practitioners in Hawaii and Polynesia have used *Morinda citrifolia* L. (Noni) for centuries to cure or prevent varieties of illnesses. The popularity of *M. citrifolia* as a dietary supplement, a food functional ingredient, or as a natural health enhancer is increasing throughout the world. *M. citrifolia* contains phytochemicals that own antibacterial, antiviral, antifungal, antitumor, anthelminthic, analgesic, hypotensive, anti-inflammatory and immune enhancing effects. Moreover, the increasing vogue of *M. citrifolia* has attracted industries to employ it as a part of various products and for wide applications such as a natural source of medicines and chemical reagents as well as a green insecticidal. The wide spread of *M. citrifolia* in tropical climate of the globe, from USA to Brazil reaching to Tahiti, Malaysia and Australia, contributed in enriching its uses and potentials due to the variation in harvest locations. *M. citrifolia* parts including fruits, seeds, barks, leaves, and flowers are utilized on their own for individual nutritional and therapeutical values, however, the fruit is considered to contain the most valuable chemical compounds. This review discusses in details the industrial uses and the pharmacological activities of *M. citrifolia* fruit, seed, leaf and root, along with their isolated phytochemical compounds, through describing the conducted *in vitro* and *in vivo* studies as well as clinical data.

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Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.arabjc.2015.06.018

Please cite this article in press as: Abou Assi, R. et al., *Morinda citrifolia* (Noni): A comprehensive review on its industrial uses, pharmacological activities, and clinical trialsMorinda citrifolia (Noni): A comprehensive review –>. Arabian Journal of Chemistry (2015), http://dx.doi.org/10.1016/j.arabjc.2015.06.018

Contents

1. Introduction

Morinda citrifolia is the scientific name of the commercially known plant Noni. The name *Morinda citrifolia* is also referring to the botanical name which is originally derived from the two Latin words "morus" imputing to mulberry, and "indicus" imputing to Indian, it belongs to the Rubiaceae family (Nelson, 2006). In Hawaii *M. citrifolia* called Noni, whereas in India it is called Indian mulberry and nuna, or ach. Malaysians call it mengkudu and in Southeast Asia it is called nhaut, while in the Caribbean, it is called the painkiller bush or cheese fruit (Chan-Blanco et al., 2006).

Currently, there are two recognized varieties of *M. citrifolia* (*M. citrifolia* var. citrifolia and *M. citrifolia* var. bracteata) and one cultivar (*M. citrifolia* cultivar Potteri). The most commonly found variety is *M. citrifolia* var. citrifolia, with the greatest health and economic importance. Traditional healers can recognize these varieties by the leaf size and shape, in addition to the fruit odor; however, most research has not distinguished between the different *M. citrifolia* varieties yet (Pawlus and Kinghorn, 2007).

In the early 1990s, the first commercialized products derived from *M. citrifolia* fruit in USA were lunched (Santhosh Aruna et al., 2013). Later, in 1996, *M. citrifolia* juice was introduced as a wellness drink, due to numerous reports stating its therapeutic effects (Kamiya et al., 2009). In 2003, the fruit juice of *M. citrifolia* was approved as a novel food by the European commission; however, this approval was limited to the Tahitian fruit juice and not to other products (Potterat and Hamburger, 2007). Amazingly, even with the absence of specific mechanisms of action for the claimed *M. citrifolia* effects (Kamiya et al., 2009), yet the market annual sales of *M. citrifolia* products claimed to reach up to US $ 1.3 billion (Potterat and Hamburger, 2007).

2. Chemical constituents

Almost 200 phytochemicals were identified and isolated from different parts of *M. citrifolia* (Singh, 2012), however, up to date, the complete phytochemical composition of the *M. citrifolia* has not been fully reported. The chemical compositions and their concentrations are related significantly not only to

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