

# Screening of chemopreventive effect of naringenin-loaded nanoparticles in DMBA-induced hamster buccal pouch carcinogenesis by FT-IR spectroscopy

N. Krishnakumar · N. K. Sulfikkarali ·  
S. Manoharan · R. Madhavan Nirmal

Received: 14 March 2013 / Accepted: 29 May 2013 / Published online: 9 June 2013  
© Springer Science+Business Media New York 2013

**Abstract** The aim of the present study is to investigate the chemopreventive effects of the prepared naringenin-loaded nanoparticles (NARNPs) relative to efficacy of free naringenin (NAR) in modifying the functional, structural, and compositional changes at the molecular level during 7, 12-dimethylbenz[a]anthracene (DMBA)-induced hamster buccal pouch (HBP) carcinogenesis by Fourier transform infrared (FT-IR) spectroscopy. The results revealed that a significant increase in the amount of proteins and nucleic acid contents and a decrease in the amount of lipids and glycogen contents are observed in DMBA-induced tumor tissues. In addition, in tumor tissues a decrease in lipid order and a significant increase in membrane dynamics were noticed. Further, the composition and secondary structure of proteins were found to be altered, which indicates some important structural alterations in the existing proteins and/or the expression of new types of proteins occurring under the tumor transformation. Furthermore, oral administration of free NAR and NARNPs significantly increased lipids and their order as well as increased the glycogen contents and decreased the levels of proteins and nucleic acid contents. On a comparative basis,

NARNPs were found to have a more potent antitumor effect than free NAR in completely preventing the formation of squamous cell carcinoma and in improving the biochemical constituents to a normal range in DMBA-induced HBP carcinogenesis. The present study further shows a great potential of FT-IR spectroscopy as a complimentary tool for the screening of various anticancer drugs and follow-up, which may allow faster response to critical problems arising during treatment.

**Keywords** Naringenin · Nanoparticle · Hamster buccal pouch carcinogenesis · FT-IR spectroscopy

## Introduction

Oral squamous cell carcinoma (OSCC) is one of the most common malignancies in the oral cavity and also the fifth most common malignancies worldwide. OSCC accounts for 90 % of all oral cancers. In Southeast Asia, the rate of incidence and mortality due to oral cancer are notably higher than many parts of the world [1]. While oral cancer accounts for 3–4 % of all cancers in Western industrialized countries, this accounts for 40–50 % of all cancers in developing countries including India [2]. Betel quid chewing with tobacco, a common practice in India, has been identified as the single most important factor in the etiology of oral cancer. Despite extensive improvement in the diagnosis and advancement in the treatment strategy, the five-year survival rate of this disease has not improved over the last 4–5 decades [3]. Chemoprevention is thus gaining considerable attention as a promising and alternative strategy for cancer control.

Cancer chemoprevention is defined as the uses of natural products that inhibit the development of invasive cancer either by blocking DNA damage or by arresting the

---

N. Krishnakumar (✉) · N. K. Sulfikkarali  
Department of Physics, Annamalai University, Annamalainagar,  
Chidambaram 608 002, Tamilnadu, India  
e-mail: nskumarphyamu@gmail.com

S. Manoharan  
Department of Biochemistry and Biotechnology, Annamalai  
University, Annamalainagar, Chidambaram 608 002, Tamilnadu,  
India

R. M. Nirmal  
Department of Oral and Maxillofacial Pathology, Rajah Muthiah  
Dental College & Hospital, Annamalai University,  
Annamalainagar, Chidambaram 608 002, Tamilnadu, India