

# Synergistic effects of curcumin with emodin against the proliferation and invasion of breast cancer cells through upregulation of miR-34a

Jiaoli Guo · Wenping Li · Hongliu Shi · Xinhua Xie ·  
Laisheng Li · Hailin Tang · Minqing Wu · Yanan Kong ·  
Lu Yang · Jie Gao · Peng Liu · Weidong Wei · Xiaoming Xie

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**Abstract** Curcumin, a biphenyl compound derived from rhizome, is a powerful anti-cancer agent. Emodin is an active component isolated from the root and rhizome of *Rheum palmatum* that has been widely used in traditional Chinese medicine for the treatment of various diseases. Currently, there are no studies examining the effect of curcumin in combination with emodin on tumor cell growth. In this study, we report for the first time that combined curcumin and emodin administration synergistically inhibits proliferation (MTT assay), survival (flow cytometry), and invasion (transwell migration assay) of

breast cancer cells. Synergism is determined by the Chou–Talalay method. Moreover, we demonstrate that miR-34a is upregulated by curcumin and emodin. This microRNA helps mediate the anti-tumor effects of curcumin and emodin by downregulating Bcl-2 and Bmi-1. Our results not only provide insight into the mechanism of synergy between curcumin and emodin in breast cancer cells, but also suggest a new and potentially useful approach for breast cancer therapy.

**Keywords** Curcumin · Emodin · Synergism · miR-34a · Breast cancer

Jiaoli Guo and Wenping Li contributed equally to this study.

J. Guo · X. Xie · H. Tang · M. Wu · Y. Kong · L. Yang ·  
J. Gao · P. Liu · W. Wei (✉) · X. Xie (✉)  
Department of Breast Oncology, Sun Yat-Sen University Cancer  
Center, 651 East Dong Feng Road, Guangzhou 510060,  
People's Republic of China  
e-mail: weiwd@sysucc.org.cn

X. Xie  
e-mail: xiexm@sysucc.org.cn

J. Guo · H. Shi · X. Xie · H. Tang · M. Wu · Y. Kong ·  
L. Yang · J. Gao · X. Xie  
State Key Laboratory of Oncology in South China, Sun Yat-Sen  
University Cancer Center, Guangzhou 510060,  
People's Republic of China

W. Li  
Department of Breast Disease, Maternal and Children  
Metabolic-Genetic Disease Key Laboratory of Guangdong  
Women and Children Hospital, Guangzhou 510623,  
People's Republic of China

L. Li  
Department of Laboratory Medicine, The First Affiliated  
Hospital of Sun Yat-Sen University, Guangzhou 510080,  
People's Republic of China

## Introduction

Breast cancer is the most common cancer among women worldwide. Although significant progress in breast cancer diagnosis and therapy has been made in recent years, this disease still has the highest incidence rate of any cancer and is expected to account for 29 % (226,870) of all new cancer cases among women in 2012 [1, 2]. Metastasis and drug resistance still pose major problems despite therapeutic advances in surgery, radiation, and targeted therapy [3–7]. Thus, new, more effective therapies are still needed for improved treatment of breast cancer.

Curcumin (diferuloylmethane, Cur) is a biphenyl compound derived from the rhizome, *Curcuma longa*. Curcumin possesses strong anti-proliferative, anti-inflammatory, anti-microbial, and anti-oxidant effects [8–11]. These attributes make curcumin a promising therapeutic agent, and several recent publications have reported on the use of curcumin in modern medicine [12–14].

Emodin (1,3,8-trihydroxy-6-methylantraquinone, Emo), an active component isolated from the root and rhizome