Chapter 1

Introduction

1.1 Background

Colorectal cancer (CRC) is the third most frequently diagnosed cancer globally and the second most common cause of cancer mortality (Kumar et al., 2023). In Taiwan, CRC had a standardized age mortality rate of 18.34 per 100,000 people and a prevalence of 261.24 per 100,000 people in 2021, indicating a major health burden (Liu et al., 2025). One of the major contributors to CRC mortality is metastasis, which causes the cancer to spread from the colon to distant organs such as the liver and peritoneum (Islam et al., 2022; Pretzsch et al., 2019). This metastatic behavior is one of the primary causes of treatment failure and poor prognosis, with a 5-year survival rate of only approximately 14% (Shin et al., 2023).

Standard treatments involve surgery, radiotherapy, chemotherapy, and immunotherapy. Nevertheless, roughly half of the patients experience the disease recurrence due to drug toxicity which causes harmful effects on healthy cells. It is also reported that 45.7% of chemotherapy patients experienced moderate to severe toxicities, with 22.9% of them experiencing gastrointestinal toxicity. (Han et al., 2024; Kumar et al., 2023). The limitations in the standard treatment highlight the need to identify novel therapeutic agents that can target CRC with improved safety.

Dietary-derived bioactive compounds from plants have gained increasing attention as anticancer agents due to their diverse biological activity, including antioxidant, anti-inflammatory, and antiproliferative effects (Bracci et al., 2021). Taro (*Colocasia esculenta*) have gained attention due to its potential anti-cancer properties (Pereira et al., 2020). Ecological observation also provides supporting context on taro's therapeutic potential. The Yami tribe, native to the Lanyu island, Taiwan consumes taro as the main staple food and has no reported standardized CRC mortality rate from this

tribe over the past eight years (Council of Indigenous Peoples, 2021). While this observation may be influenced by confounding factors such as population size, lifestyle factors, or genetics it provides a preliminary rationale for further research. In addition taro contains various bioactive compounds that may exert health benefits and anticancer properties (Brandão et al., 2023; Pereira et al., 2020). Notably, it has a unique protein called tarin that can exhibit anti-proliferative and anti-migratory properties.

Despite promising bioactive properties of taro, crude extracts may be prone to degradation, leading to poor stability (García-Jiménez et al., 2024). Therefore, there is a growing interest in natural delivery systems to enhance the stability of bioactive molecules. Plant-derived nanovesicles (PDNV) have emerged as a potential therapeutic agent for cancer therapy. PDNV is a nano-sized membrane-bound vesicle naturally released from plant cells that carry bioactive materials such as nucleic acids, proteins, and lipids (Li et al., 2023; Zheng et al., 2025). PDNV also shares similar structural properties to mammalian extracellular vesicles, which enable efficient transfer of plant bioactive compounds to mammalian cells. Due to its anti-cancer effect, high biocompatibility, stability, and intrinsic targeting capabilities, PDNV has gained attention in biomedical research as a potential anticancer agent (Huang et al., 2025; Zuo et al., 2026). While PDNV from other plant sources such as ginger, fingerroot, and ginseng have been studied for cancer therapy, the effectiveness of taro derived nanovesicle (TDNV) remains underexplored. Currently, there is no established, optimized method for extracting TDNV and its anti-cancer effect has not been explored.

1.2 Objectives

The primary objective of this study is to identify a suitable purification method to isolate TDNV and assess its quality, while evaluating its anticancer potential against CRC cells. This research serves as a preliminary study to provide initial evidence for TDNV potential application in CRC research. The specific sub-objectives are:

1. To evaluate different purification methods for TDNV
2. To characterize the physicochemical properties such as particle concentration, morphology, size, zeta potential, and total protein concentration
3. To investigate TDNV effect on HCT116 cell viability and migration in a dose-dependent manner using cell counting kit-8 (CCK-8) assay and wound healing assay

1.3 Hypothesis

It is hypothesized that TDNV can be successfully purified and characterized with a vesicle-like characteristics (nanoparticle size, negative zeta potential, and spherical shape), and that the TDNV will exert a dose-dependent inhibitory effect on HCT116 cell viability and migration.

1. TDNV Purification

It is hypothesized that different purification methods using ultracentrifugation and SEC will result in significant differences in TDNV recovery indicated by the protein concentration.

2. TDNV Characterization Hypothesis

It is hypothesized that TDNV will exhibit a vesicle-like physical characteristic, including nanoparticle size, negative zeta potential, and spherical shape.

3. Viability and MIgration Hypothesis

It is hypothesized that TDNV treatment will significantly reduce the viability and migration of HCT116 cells in a dose-dependent manner.