UNIVERSITI TEKNOLOGI MARA

PROPERTIES OF MILLED *ZINGIBER OFFICINALE* ROSC (GINGER) RHIZOME POWDER TO COARSE, FINE AND NANO SIZES AND ITS EFFECTS ON THE STORAGE STABILITY OF SPENT HEN CHICKEN

NORHIDAYAH BINTI ABDULLAH

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledge as referenced work. This thesis has not been submitted to any academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Norhidayah Binti Abdullah
Student I.D. No	:	2010745867
Programme	:	Doctor of Philosophy – AS990
Faculty	:	Applied Sciences
Thesis Title	:	Properties of Milled *Zingiber officinale* Rosc (Ginger) Rhizome Powder to Coarse, Fine and Nano Sizes and Its Effect on the Storage Stability of Spent Hen Chicken
Signature of Student	:	.....
Date	:	March 2017

ABSTRACT

Z. officinale Rosc. (ginger) has been globally used and known to possess beneficial health properties due to the presence of various bioactive compounds. However, the poor absorption of these bioactive compounds is due to low water solubility, large particle size and complex chemical structure had restricted its bioactivity. The nanotechnology process has been reported as an advanced technology recently applied in food materials to increase the water solubility and improve bioactivity of the active ingredients. However, study on nanoparticle herbs is lacking, hence this study was conducted with the aimed to investigate the effect of nanotechnology process on physicochemical properties of nanoparticle *Z. officinale* rhizome powder. A study on the effect of this powder as a marinating agent on the storage stability of spent hen meat was also conducted. Physicochemical changes were determined using laser diffraction technique, Field Emission Scanning Electron Microscope (FESEM), The Fourier Transmittance IR (FTIR) and X-ray diffraction (XRD). Antioxidant content was estimated by Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) while antioxidant activity was performed via ABTS Cation Decolorisation Assay (ABTS), DPPH Radical Scavenging Activity (DPPH) and Ferric Reducing Antioxidant Power (FRAP) assays. Phenolic acids composition was identified through SPE-HPLC analysis. Analyses of pH, colour, shear force, Peroxide Value (PV), Thiobarbituric Acid (TBA), Anisidine Value (AV), Totox Value, volatile compounds identification by GCMS-SPME method and microbiological study were conducted to determine the storage quality of chilled spent hen meat treated with synthetic antioxidant, BHA:BHT combination (positive control), coarse particle, fine particle and nanoparticle *Z. officinale*. The results were compared to that of spent hen meat without any treatment (negative control). Sensory analysis was also conducted to verify consumers' acceptability. Milling at 550 rpm for 4 hours in dry milling were found to be the appropriate milling parameters to prepare nanoparticle *Z. officinale* rhizome with mean particle size of 223.8 nm. The TPC and TFC were in the range of 3.97 to 12.83 mgGAE/g dry weight and 14.80 – 22.35 mgQE/g dry weight respectively. Nanoparticle *Z. officinale* showed significantly high ABTS scavenging (38.08%), FRAP value (50.52%) and 34.04% better in the DPPH free radical inhibition as compared to the coarse particle *Z. officinale* rhizome powder. Nanoparticle *Z. officinale* significantly inhibited bacterial growth better than the coarse and fine particle *Z. officinale* rhizome powder. Application of nanoparticle *Z. officinale* rhizome in spent hen meat improved physicochemical properties and oxidative stability as comparable to sample marinated with BHA:BHT. Significantly low concentration of volatile compounds were detected in the nanoparticle *Z. officinale* rhizome marinated sample compared to other treated samples. Spent hen marinated with nanoparticle *Z. officinale* rhizome was the most preferred sample as depicted by significantly high sensorial mean scores (6.86 – 7.60) rated by the panelists. Hence it is suggested that nanoparticle *Z. officinale* rhizome has the potential to be used as functional ingredient that can improved the storage stability of meat and meat product.

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CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND

Nanotechnology has been identified as a technology of the 21st century with great potential and is one of the contributors to the economic development imperative for biotechnology and information communication technology (ICT). In Malaysia, the nanotechnology field has been categorised as one of the key technologies under the 2nd National Science and Technology Policy which led to the development of the Nano Malaysia Program. This program is expected to contribute 1% to 3% of the economic growth by the year 2020 (Uda et al., 2009). Nanotechnology is the technology involves in the manufacturing and development of materials in the nanoparticle dimension which is less than 100 nm (Bouwmeester et al., 2009). However, due to numerous successful applications by employing nanomaterial with particle size above 100 nm, it is agreed that cut off 100 nm for nanoparticle is arbitrary (David, 2010). Thus nanoparticle is also define as particles in the range of 10 nm to 1000 nm (Ratnam et al., 2006). While Brigger et al. (2002) defined nanoparticle as a colloidal system with particle size less than 1μm. Nowadays, nanotechnology has been applied to biomaterials, particularly plants. This is due to the larger particle size, low water solubility and complex chemical structure of plants that limit the absorption of active compounds, hence reducing the bioactivity. Thus application of the nanotechnology process could improve the bioactivity of plants.

The nanotechnology process leads to some changes in the physicochemical properties and brings some novel characteristics that cannot be obtained in the larger materials. Su et al. (2006) revealed that the nanotechnology process increased the extraction yield and enhanced the bioactivity effectiveness of *R. chuanxiong*. The nanotechnology process has been found to break the cellular tissues down into pieces and enlarge the surface area. The larger surface area allows the material to disperse stably and homogeneously as compared to the larger particle size material. Additionally, the well dispersed nanoparticles may also contribute to the full