

**UNIVERSITI TEKNOLOGI MARA CAWANGAN
SELANGOR KAMPUS PUNCAK ALAM**

**"Development & Sensory Evaluation of Banana Cake Enriched with
Iron and Fibre Through the Incorporation of Red Spinach
(*Amaranthus tricolor L.*) Powder"**

NURUL HANIS BATRISYIA BINTI SAHA

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*Kau dan aku saling membantu
Membasuh hati yang pernah pilu
Mungkin akhirnya tak jadi satu
Namun bersorai pernah bertemu*

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ABSTRACT

Women have a higher prevalence of iron deficiency compared to men due to basal iron loss and menstrual losses. Besides that, it is also found that a total of 94.8% of women in Malaysia have a low consumption of dietary fibre (vegetables and fruits). While many studies have investigated the incorporation of green spinach powder in food, limited research has examined the utilization of red spinach powder in cake formulation. This study aims to develop a fibre and iron-enriched banana cake incorporated with Red Spinach (*Amaranthus tricolor L.*) powder, to assess their nutrient content, and to evaluate the sensory properties of newly developed functional banana cake. Banana cake was incorporated with RSP at four percentages of 4%, 6%, 8%, and 10%. Proximate analysis was conducted (moisture, ash, crude fat, crude protein, and carbohydrate) following the AOAC procedures. The iron and dietary fibre contents of sample 6% were analyzed by an accredited external laboratory (UNIPEQ, UKM) using a standard method. The sensory evaluation involved 35 untrained female panellists. The sensory evaluation examined the sensory attributes of colour, aroma, flavour, texture, porosity (crumb), and overall acceptability. The addition of RSP brings a significant difference in colour ($p < .001$), texture ($p = .043$), flavor ($p = .015$), and overall acceptance ($p < .001$). The highest acceptability of samples can be seen in samples of 6% RSP substitution with the most favorable balance of nutrition and acceptability. Banana cake enriched with 6% RSP contains 5.6 mg of iron per 100 g, qualifying the “high in iron” status and 3.4g of dietary fibre per 100g, qualifying the “source of fibre” status under the Malaysian nutrition labelling guidelines. The addition of RSP in banana cake shows an increasing trend of protein and a decreasing trend of fat. This study concludes that RSP has a strong potential as a functional ingredient in baked goods at incorporation below a 10% level. Further research is recommended to investigate further the relationship between RSP and iron’s bioavailability and the effects of long-term storage on the product’s quality.

Keywords: Banana cake, red spinach powder, sensory evaluation, proximate analysis

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CHAPTER I

INTRODUCTION

1.1 Research Background

Dietary fibre varies from other nutrients as it is an umbrella for a diverse group of different compounds. As dietary fibre passes through the gastrointestinal tract, the various forms, including the differences in its physicochemical and functional properties (e.g., chain length, kind of polymer bonds, solubility, viscosity, and fermentability), will have a varying health impact on the body. (Gemen et al., 2011; Stewart et al., 2010; Kranz et al., 2012). Dietary fibre is categorized as the top four nutrients, apart from sodium, total fat, and saturated fat, which are usually included for assessing links between human health and dietary patterns in dietary metrics. (Miller et al., 2020; Mathers, 2023).

According to the Institute of Medicine (IOM), dietary fibre is defined as non-digestible carbohydrates and lignin that are intrinsic and intact in plants. These include cellulose, pectin, lignins, gums, hemicellulose, β -glucans, and fibres (that were found in oats and wheat bran), plant carbohydrates that cannot be recovered via alcohol precipitation (e.g., inulin, oligosaccharides, fructans), and resistant starch. (Institute of Medicine, 2001; USDA, 2005). On the contrary, functional fibres are known as fibre that provides benefit to health, including but not restricted to isolated nondigestible plants (e.g., pectin, gums, and resistant starch) (Trumbo et al., 2002).

Iron, on the other hand, is also an essential nutrient that is needed by the human body to perform metabolic functions that act as a cofactor of several enzymes and a significant component of oxygen transporters in the body (Bao et al., 2012). Iron is mostly obtained from dietary sources and is then stored in the body. Heme (iron that is found in