



**NUTRITIONAL COMPOSITION, HEAVY METALS AND
ANTIOXIDATIVE PROPERTIES OF MULTIGRAIN BEVERAGE POWDER**

By

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DECLARATION BY AUTHOR

This dissertation is composed of my original work and contains no material previously published or written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify for the award of any degree or diploma in any university or other tertiary institution.

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LIST OF ABBREVIATIONS

Abbreviations	Caption
%	Percentage
°C	Degree celcius
μL	Microliter
μmol	Micromole
AACC	American Association of Cereal Chemists
ABTS	2, 2'-Azino-Bis-3-Ethylbenzothiazoline-6-Sulfonic Acid
ABTS•+	ABTS cation radical
AOAC	Association of Analytical Communities
ATP	Adenosine Tri-Phosphate
BHA	Butylated hydroxyanisole
BHT	Butylated hydroxytoluene
Ca	Calcium
Cd	Cadmium
Cu	Copper
CuSO ₄	Copper sulphate
CVD	Cardiovascular disease
DNA	Deoxyribonucleic acid
DPPH	2,2-diphenyl-1-picryl-hydrazyl-hydrate
DPPH•	DPPH radical
FAAS	Flame Atomic Absorption Spectroscopy
FAO	Food and Agriculture Organization
Fe	Iron
Fe ²⁺	Iron (II) ion

FRAP	Ferric reducing antioxidant power
g	Gram
H ₂ O ₂	Hydrogen peroxide
H ₂ SO ₄	Sulphuric acid
HCl	Hydrochloric acid
HNO ₃	Nitric acid
IDF	Insoluble dietary fibre
K	Potassium
L	Litre
La ₂ SO ₄	Lanthanum oxide
LDL	Low density lipoprotein
MES	2-(N-morpholino)ethanesulfonic acid
Mg	Magnesium
mg	Milligram
ml	Millilitre
Mn	Manganese
MoH	Ministry of Health
NaOH	Sodium hydroxide
nmol	Nanomoles
Pb	Lead
ppm	Part per million
RNA	Ribonucleic acid
RNI	Recommended nutrient intake
SD	Standard deviation
SDF	Soluble dietary fibre
t	Temperature
TDF	Total dietary fibre

TE	Trolox equivalent
TPC	Total phenolic content
TPTZ	2,4,6-Tripyridyl-s-triazine
TRIS	hydroxymethylaminomethane
USDA	United States Department of Agriculture
w/v	Weight to volume
WHO	World Health Organization
Zn	Zinc

KOMPOSISI NUTRISI, LOGAM BERAT DAN CIRI-CIRI ANTIOKSIDAN DALAM SERBUK MINUMAN BIJIRIN CAMPURAN

ABSTRAK

Permintaan terhadap pilihan makanan dan minuman yang sihat semakin meningkat di seluruh dunia disebabkan oleh gaya hidup yang lebih sihat. Oleh itu, produk campuran bijirin dicipta. Multigrain terdiri daripada lebih daripada satu jenis bijirin seperti gandum, jagung, biji wijen, beras, bijirin dan lain-lain. Kajian ini bertujuan untuk mengkaji komposisi nutrisi, logam berat dan sifat antioksidan serbuk minuman multigrain. Komposisi pemakanan ditentukan dengan mengukur kandungan proksim (kelembapan, lemak, protein, abu, serat mentah dan karbohidrat), serat makanan (jumlah, tidak larut dan larut), logam berat (Pb dan Cd) dan mineral (Ca, K, Fe, Zn, Cu, Mn dan Mg). Dari hasilnya, komposisi nutrisi serbuk multigrain mempunyai karbohidrat yang lebih tinggi ($75.6 \pm 0.30\%$) dan abu ($3.8 \pm 0.00\%$) tetapi lebih rendah dalam kelembapan ($5.9 \pm 0.40\%$), lemak ($6.5 \pm 0.70\%$) dan protein ($8.2 \pm 0.20\%$) berbanding dengan campuran bijirin lain daripada kajian terdahulu. Sampel juga lebih tinggi daripada bijirin tunggal dari segi jumlah serat makanan ($17.5 \pm 0.30\%$) dan mineral (kalium: 778.7 ± 95.4 mg / 100 g dan magnesium: 111.2 ± 2.2 mg / 100 g). Serbuk campuran bijirin juga mempunyai tahap kadmium dan jumlah plumbum yang boleh diterima. Ciri-ciri antioksidan sampel dianalisis dengan tiga kaedah berbeza: DPPH, FRAP dan ABTS. Hasilnya menunjukkan bahawa antioksidan dalam campuran multigrain (FRAP: 12.3 mg Trolox / g berat kering & ABTS: 4.8 mg / Trolox / g berat kering) adalah lebih tinggi daripada bijirin tunggal seperti bran padi dan sekam padi. Sampel kajian ini mempunyai antioksidan yang lebih tinggi (DPPH: 86.3%) berbanding nilai DPPH dengan kajian sebelumnya (campuran bijirin yang berbeza).

NUTRITIONAL COMPOSITION, HEAVY METALS AND ANTIOXIDATIVE PROPERTIES OF MULTIGRAIN BEVERAGE POWDER

ABSTRACT

The demand on healthier choice of food and beverages is increasing around the world due to a healthier lifestyle. Therefore, multigrain products are created. The multigrain consists of more than one grain types such as wheat, corn, sesame seed, rice, millet and other. This study is aimed to investigate the nutritional composition, heavy metals and antioxidative properties of multigrain beverage powder. The nutritional composition was determined by measuring the proximate content (moisture, fat, protein, ash, crude fibre and carbohydrates), dietary fibre (total, insoluble and soluble), heavy metals (Pb and Cd) and minerals (Ca, K, Fe, Zn, Cu, Mn and Mg). From the results, the nutritional composition of multigrain powder had higher carbohydrate (75.6 ± 0.30 %) and ash (3.8 ± 0.00 %) but lower in moisture (5.9 ± 0.40 %), fat (6.5 ± 0.70 %) and protein (8.2 ± 0.20 %) compared with other multigrain mix from previous study. The sample also had higher than single grain in term of total dietary fibre (17.5 ± 0.30 %) and trace elements (potassium: 778.7 ± 95.4 mg/100 g and magnesium: 111.2 ± 2.2 mg/100 g). The multigrain powder also had acceptable level of cadmium and zero amount of lead. The antioxidative properties of the sample were analysed by three different methods: DPPH, FRAP and ABTS. The result indicated that antioxidant in multigrain mix (FRAP: 12.3 mg Trolox/g dry weight & ABTS: 4.8 mg/Trolox/g dry weight) was higher than in single grain such as in rice bran and rice husk. The sample of this study had higher antioxidant (DPPH: 86.3 %) compared to the DPPH value with previous study (different multigrain mix).