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Traditional versus commercial food processing techniques - A comparative study based on chemical analysis of selected foods consumed in rural Zimbabwe.

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*In this article, the term 'traditional' is interchangeable with the terms 'indigenous' and 'endogenous' and 'home-made'.

Abstract

With the advent of industrialisation, food processors are constantly looking for ways to cut costs, increase production and maximise profits at the expense of quality. Commercial food processors have since shifted their focus from endogenous ways of processing food to more profitable commercial food processing techniques. The aim of this study was to investigate the holistic impact of commercial food processing techniques on nutrition by comparing commercially (industrially) processed food products and endogenously processed food products through chemical analysis of selected foods. Eight food samples which included commercially processed peanut butter, mealie-meal, dried vegetables *(mufushwa)* and rice and endogenously processed peanut butter, mealie-meal, dried vegetables *(mufushwa)* and rice were randomly sampled from rural communities in the south-eastern and central provinces of Zimbabwe. They were analysed for ash, zinc, iron, copper, magnesium, protein, fat, carbohydrates, energy, crude fibre, vitamin C and moisture contents.
The results of chemical analysis indicate that endogenously processed mealie-meal, dried vegetables and rice contained higher ash values of 2.00g/100g, 17.83g/100g, and 3.28g/100g respectively than commercially processed mealie-meal, dried vegetables and rice, which had ash values of 1.56g/100g, 15.25g/100g and 1.46g/100g respectively.

The results also show that endogenously processed foods have correspondingly higher iron, zinc and magnesium contents and, on the whole, a higher protein content. The results also indicate that commercially processed foods have higher fat and energy contents. The result led to the conclusion that the foods are likely to pose a higher risk of causing adverse conditions to health, such as obesity and cardiovascular diseases to susceptible individuals. Based on these findings, it can, therefore, be concluded that endogenously processed foods have a better nutrient value and health implications than commercially processed foods.
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Keywords: endogenously processed foods; commercially processed foods

1. Introduction

Endogenously processed foods form a major part of the diet of most elderly rural African folks. Alternative and non conventional methods of preparing foods have been developed (Madruga and Camara, 1999) and are termed commercial food processing techniques. This research was based upon comparing the nutrient contents of selected foods processed applying traditional (indigenous/endogenous) methods comparing with those processed applying modern (commercial) processing techniques. Endogenously food processing techniques involve mainly manual, small scale processing techniques passed on from generation to generation and commercial food processing techniques involve modern, mechanical and large scale food processing techniques.

The comparisons were done by chemical nutrient analysis of both commercially and endogenously processed selected foods of peanut butter, mealie-meal, dried vegetables and rice which are among the most consumed foods by black Africans in Southern Africa (Charlton et. al., 2005). It is recommended to carry out further studies and make recommendations on foods that are in line with the established food habits of indigenous people which are culturally acceptable (Baingana 2004).

The food value parameters tested include ash, zinc, iron, copper, magnesium, protein, fat, carbohydrates, energy, crude fibre, vitamin C and moisture content these nutrients. The trace mineral content of foods is important to the growth of children, particularly in developing countries (Bond et.al 2004) but excess of these nutrients may pose a health risk, especially the toxicologically significant amounts that can lead to adverse health effects (Kroes 2002). The Food and Agricultural Organisation (FAO) and World Health Organisation (WHO) jointly established a global food standards programme called codex alimentarius (codex) whose goal is to synchronise standards for the various food parameters, aiming to assure consumer safety and facilitate trade (MacLean 2009). However, food producing companies have to carry out their own risk assessments which can be both business management and legal requirement (Kleter and Marvin 2008), although the same cannot be said for small scale indigenous food producers owing to the difficulty of imposing legislation on them.

Established laboratory methods for accurately determining these nutrients in foods often require expensive equipment and potentially hazardous reagents (Kosse 2001). Validated Association of Analytical Chemists (AOAC) methods were used for the entire analysis as the standardised AOAC analytical methodology and AOAC developed quality contol system ensure analytical measurement validity and increased data reliability (Puwastein et. al 2009).

2 Materials and Methods

2.1 Area of study

The study area included three of the ten provinces of Zimbabwe, namely Manicaland, Masvingo and Midlands Provinces. The three selected provinces occupy the south-east-central area of the country. All three provinces share common climatic conditions and food production patterns, thus people use the same food processing techniques.

Collection of food samples

The following eight food samples were collected from the study area

1. Commercially processed peanut butter
2. Traditionally processed peanut butter
3. Commercially processed mealie-meal
4. Traditionally processed mealie-meal
5. Commercially processed dried vegetables
6. Traditionally processed dried vegetables
7. Commercially processed rice
8. Traditionally processed rice

The Traditionally processed food samples were collected mainly from rural communities which are; Chiefs Makumbe, Marange and Sawunyama communal areas in Manicaland province, Chiefs Mazungunye and Zimuto communal areas in Masvingo Province and Chiefs Chirimhanzi and Mutevaidzi communal areas in the Midlands Province. Elderly females aged sixty years and above were consulted and

contracted to supply the traditional food samples as they exhibited more knowledge and skills pertaining to the traditional food processing techniques compared to individuals of other age groups and gender. The commercially processed foods were supplied by the same women and sourced from their respective local shops.

2.2 Instrumentation

A Varian Atomic absorption/ emission spectrometer was used in the determination of trace elements. Iron, Zinc, Copper and Magnesium hallow cathode lamps were used for their corresponding elemental analysis. Other instruments used include a muffle furnace with a temperature at 550 degrees Celsius, a drying oven with a temperature of up to 105 degrees Celsius, a digestion hot plate with maximum temperature of 300 degrees Celsius and a hot plate with a maximum temperature of 200 degrees Celsius.

3. Chemical Analysis

Collecting representative samples, preserving their condition during transport and sample preparation are of paramount importance in the quality control of foods (Peris 2001). The samples were randomly sampled and transported to the laboratory in plastic bags designed to maintain the integrity of their nutritional composition and analysis was initiated within two days after the sampling day.

3.1 Analysis of ash

The dry ashing method was used in the determination of the total ash content of the foodstuffs. 2 grams of each respective sample was accurately measured into a porcelain crucible and after charring on a hot plate, each sample was placed in a muffle furnace at a temperature of 550 degrees Celsius for eight hours before cooling in a desiccator for 1 hour. The masses of each respective sample before and after ashing were recorded and the total ash content was calculated as follows;

Ash % = initial mass – final mass (after ashing) X100.

3.2 Analysis of moisture

The moisture content of the foodstuffs was determined by weighing 2 grams of each respective food sample into a watch glass. The samples were then placed in a hot oven at 105 degrees Celsius and the mass recorded after 2 hours and 1 hour thereafter until there was no further change in mass. The samples were cooled in desiccators for 15 minutes each time prior to recording the temperature. The total moisture content was calculated as follows;

$$\% \text{ Moisture} = \frac{M_{initial} - M_{dried)}}{M_{initial}} \times 100$$

Where $M_{initial}$ = mass of samples before drying

M_{dried} = mass of samples after drying.

3.3 Analysis of fat

The Werner Schmidt method was used for fat analysis of the food samples. 2 grams of each respective sample was accurately weighed into a quick fit test tube with a special adjustable Dresher bottle head. The fat portion was hydrolysed from other food components by addition of 5ml concentrated hydrochloric acid and heating the test tube in a water bath at 100 degrees Celsius for 30 minutes. After cooling the test tubes for 15 minutes a combination of organic solvents (diethyl ether, hexane and ethanol) were then used to extract the fat from the samples using centrifugal force, extracting into a beaker whose mass had been pre-recorded. The organic solvents were evaporated off by placing the beaker in a hot oven at 105 degrees Celsius for 15 minutes or until all the organic solvent had evaporated. The beaker was allowed to cool in a desiccator for 15 minutes before the mass was recorded.

The total fat content of the food samples were calculated as follows:

$$\% \text{ Fat} = \frac{\text{mass of beaker}}{\text{mass of beaker + fat}} \times 100$$

3.4 Analysis of protein

The Kjeldahl method was used for the determination of the protein content of the foodstuffs. The Kjeldahl method consists of 3 steps, namely digestion, distillation and titration.

3.4.1 Digestion

1 gram of each sample was accurately measured into a Kjeldahl flask together with 20 ml concentrated sulphuric acid, zinc metal, anhydrous sodium sulphate, and anhydrous copper sulphate tablets as catalysts. Anti-bumping glass beads were added into the flask before it was placed on a digestion hot plate at approximately 300 degrees Celsius for 1 hour or until the solution was clear, showing that the sample was completely digested. After digestion, the sample was allowed to cool for 30 minutes and 50 ml distilled water was added to each sample before starting the distillation process.

3.4.2 Distillation

3 drops of phenolphthalein indicator and 100 ml of 50% sodium hydroxide solution were added to the sample solution prior to connecting the digestion flask to a rapid still which was connected to a reflux condenser. The other end of the condenser dipped into a conical flask containing 100ml boric acid and mixed indicator. The sample was allowed to reflux until the volume of the conical flask reached 300ml, before the conical flask was removed and taken to the titration apparatus.

3.4.3 Titration

A burette was filled up with 0.1 normal sodium hydroxide solutions, with the initial burette reading being recorded. The titrant was added slowly to the sample until it reached the end point and the final burette reading recorded. The protein content was then calculated as follows;

$[(Vb - Vs)(N)(1.4007) / (W)] \times F$ = percent protein

Where;

Vb = millilitres titrant for the blank(s)
Vs = millilitres titrant for the individual samples
N = Normality of the acid titrant (nominally 0.1)
1.4007 = a single factor that takes into account the molecular weight of nitrogen, the conversion of the milli-equivalent result of (Vb – Vs)XN, and the conversion to %.
W = the weight of sample in grams. The error is sufficiently small that, for samples weighed to 1.0000g +/- 0.0005 g, this can be assumed to be 1.

F = the factor for converting the percent nitrogen in a sample to percent protein. The general factor is 6.25

3.5 Analysis of crude fibre

Crude fibre is determined by digesting a moisture and fat free sample with a weak acid and a base (Alajaji and El-Adawy 2006). The crude fibre content of the food samples was determined by a series of step detailed below:

3.5.1. Defatting;

5 grams of the food sample was measured into an extraction thimble and the fat extracted by employing the Soxhlet method for 6 hours using hexane as the solvent.

3.5.2. 2 grams of the defatted sample was accurately measured into a conical flask and then hydrolysed by refluxing in 1.25% sulphuric acid for 45 minutes before filtering the sample and washing it with 100ml hot water.

3.5.3 The sample on the filter paper was washed into another conical flask and again hydrolysed by refluxing in 1.25% sodium hydroxide solution for 45 minutes before filtering and washing with 100ml hot water followed by 10 ml absolute ethanol.

3.5.4 The sample on the filter was dried in a hot oven at 105 degrees Celsius for 10 minutes.

3.5.5 The sample on the dry filter paper was then scrapped into a porcelain crucible and the mass recorded.

3.5.6. The porcelain crucible was then placed into a muffle furnace at 550 degrees Celsius for 6 hours, and then cooled in a desiccators for 1 hour before measuring and recording the mass.

The percentage crude fibre content was calculated as follows;

Crude fibre % = mass of crucible + sample after ashing X 100

Mass of crucible + sample before ashing

3.6 Analysis of vitamin C

The 2,6 Dichloroindolphenol titrimetric method was used to calculate the vitamin C content of the respective food samples. 2 grams of the respective food samples were first homogenized and blended before extraction with metaphosphoric acid. The extract was titrated with 2,6 Dichloroindolphenol solution to the end point. The vitamin C content of the samples was then calculated as follows;

Vitamin C (mg/100g) = I X S X (D/A) X (100/W)

Where I = millilitres of indophenols reagent used in the titration,

S = mg of ascorbic acid reacting with 1 millilitre of reagent;

D= the volume of the extract in millilitres;

A= the aliquot titrated in millilitres;

W=the weight of the sample in grams.

3.7 Analysis of carbohydrates

The percentage carbohydrate content of the food samples were calculated by difference formula as highlighted below;

Percentage carbohydrate = 100- (%Protein + %Fat + % Moisture + % Ash+ crude fibre)

3.8 Energy calculation

The energy content of the samples was calculated using the formula shown below;

Energy (KJ/g) = (% Protein + % Fat + % Carbohydrate) X 13.75 KJ/g

3.9 Analysis Trace elements (Iron, Zinc, Copper and Magnesium)

The recommended mineral content of foods differs globally from country to country (MacLean et. al 2009). Specific trace elements were determined by Atomic absorption spectroscopic (AAS) methods. 1 gram of respective sample was accurately measured into a conical flask. 10 ml deionised water and 10 ml concentrated nitric acid were also added into the conical flask before the it was placed on a hot plate, at 200 degrees Celsius for 1 hour to digest the sample. After 1 hour the sample was allowed to cool for 10 minutes before adding 5 ml concentrated sulphuric acid and placing the conical flask back onto the hot plate. Further 5ml portions of the concentrated sulphuric acid were added, after cooling until the solution turned colourless, indicating complete digestion. Ammonium oxalate solution was added finally to make the sample solution completely clear.

The sample solution was then transferred to a 100ml volumetric flask and topped up to the mark with de-ionised water before aspirating into the atomic absorption spectrometer.

Analytical methods were sourced from the AOAC (2005).

4. Quality assurance

To assure the quality of the analytical results, only internationally approved and validated methods of analysis from the Association of Analytical Chemists (AOAC) were used for the analyses. The instruments and experimental conditions used were set according to the manufacturer's specifications and reagents were calibrated against standard reference compounds. A quality control (QC) sample was run together with all respective samples to ensure the quality of the analytical process. The samples were analysed in duplicate for validity of results and two blank samples were also analysed accordingly with each respective sample. These quality control procedures assess the analyst's analytical prowess and reflect on the reliability of the analytical data (Puwastein 2009).

4.1 Reagents and standards.

All chemicals used were at least analytical grade and were supplied by Merk.

5. Results and Discussion

Nutrient results of chemical analysis of endogenously and commercially processed food samples per 100g

Method/ Media used	Parameter	H/m peanut butter	C/m pea nut butter	H/m mealie meal	C/m mealie meal	H/m dried vegetables	C/m dried vegetables	H/m Rice	C/m rice
Gravimetric	Ash g/100g	3.35	4.44	2.00	1.56	17.83	15.25	3.28	1.46
Gravimetric	Moisture ml/100g	0.2	0.2	7.2	6.3	3.3	2.6	1.0	3.0
Werner-Schmidt	Fat g/100g	44.87	48.1	28.8	30.6	ND	ND	0.03	0.04
AAS	Magnesium mg/kg	1555.98	1667.52	1835.00	1207.03	2362.17	1989.16	632.95	430.66
AAS	Copper mg/kg	6.61	6.51	1.15	3.34	7.21	10.59	1.48	3.50
Gravimetric	Crude fibre g/100g	0.61	0.66	0.79	0.94	13.75	15.16	3.12	ND
AAS	Iron mg/kg	28.54	70.35	10.00	8.98	279.84	227.12	18.03	10.58
AAS	Zinc mg/kg	25.85	25.06	17.15	27.15	42.13	29.70	15.20	8.10
Calculation	Total Carbohydrate g/100g	ND	ND	51.21	59.72	61.76	63.08	92.41	91.16
Calculation	Energy KJ/100g	2562.7	2627.7	2130.2	2190.6	1325.0	1380.1	1608.7	1605.9
Kjeldahl	Protein g/100g	50.97	46.85	10	0.88	3.36	3.91	0.16	4.34
Titration	Vitamin C (mg/kg)	3858.6	3964.8	3959.6	3873.4	4127.8	4173.1	- -	378.2

KEY

mg/kg- milligrams per kilogram

ND- Not Detected

KJ/100g- Kilojoules per 100grams

AAS - Atomic Absorption Spectroscopy

g/100g- grams per 100grams food

ml/100g- milliliters per 100grams food

5.1 Results of chemical analyses

5.2 Protein results

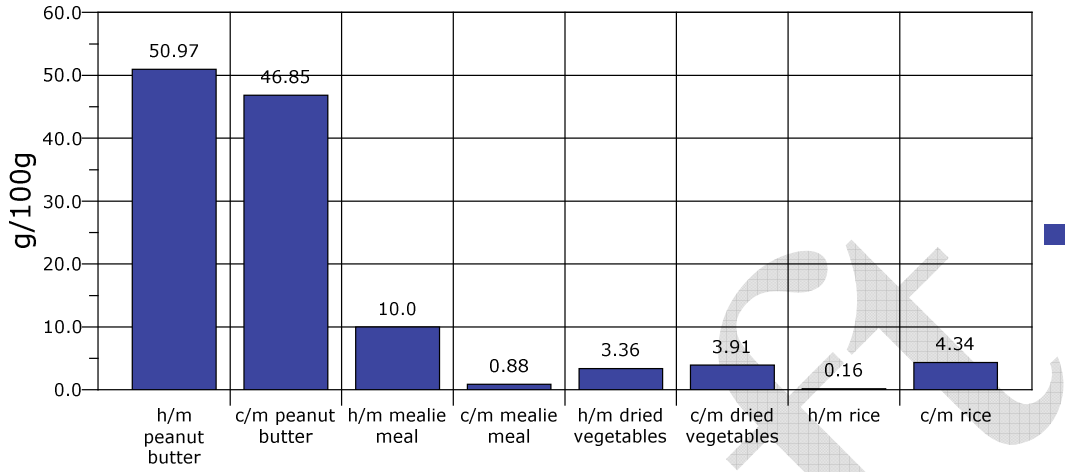

Fig. 1 Results of protein analysis

The results of protein analysis clearly show that endogenously processed peanut butter and mealie-meal showed significantly higher protein content values of 50.97 g/100g and 10 g/100g, respectively compared to commercially produced foods which contained 46.85 g/100g and 0.88 g/100g, respectively. The results of analysis indicate that endogenously processed food samples are healthier for consumption as they collectively contain higher protein values.

5.3 Fat results

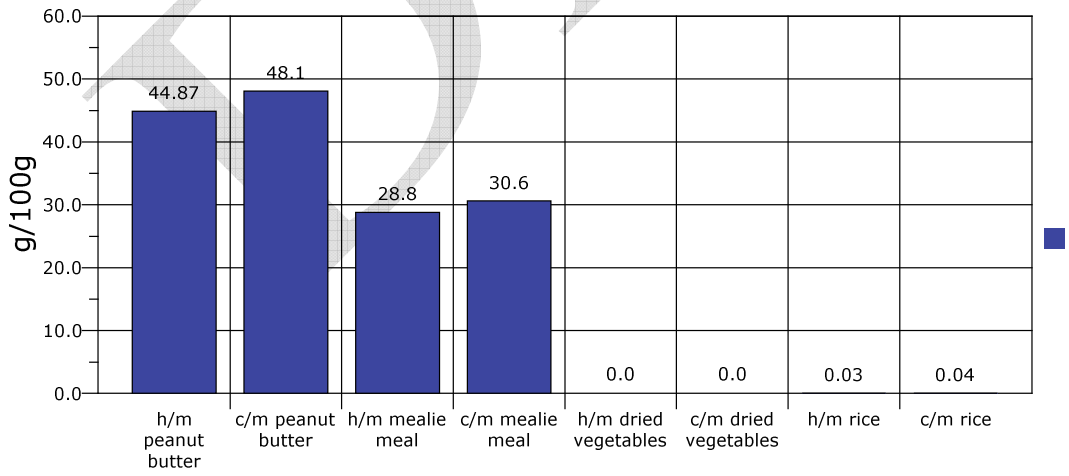

Fig. 2 Results of fat analysis

Figure 2 indicates that endogenously processed foods generally contain a less fat content than commercially processed foods, with the exception of peanut butter. Endogenously processed mealie-meal and rice had lower fat contents of 28.8 g/100g and 0.03 g/100g respectively compared to the corresponding commercially made mealie-meal and rice with values of 30.6 g/100g and 0.04 g/100g, respectively. The endogenously processed peanut butter had a lower percentage fat content of 44.87 g/100g than commercially processed peanut butter with 48.1 g/100g whilst commercially processed and endogenously processed dried vegetables showed no traces of any fat. Consequently, this shows that endogenously processed foods have better health implications as they allow a reduced fat intake and thus lower the risk of developing diseases such as hypertension and heart attack. In this respect, the Nutrition Board, Institute of Medicine, National Academics do not have any EAR values for fat intake.

5.4 Carbohydrate results

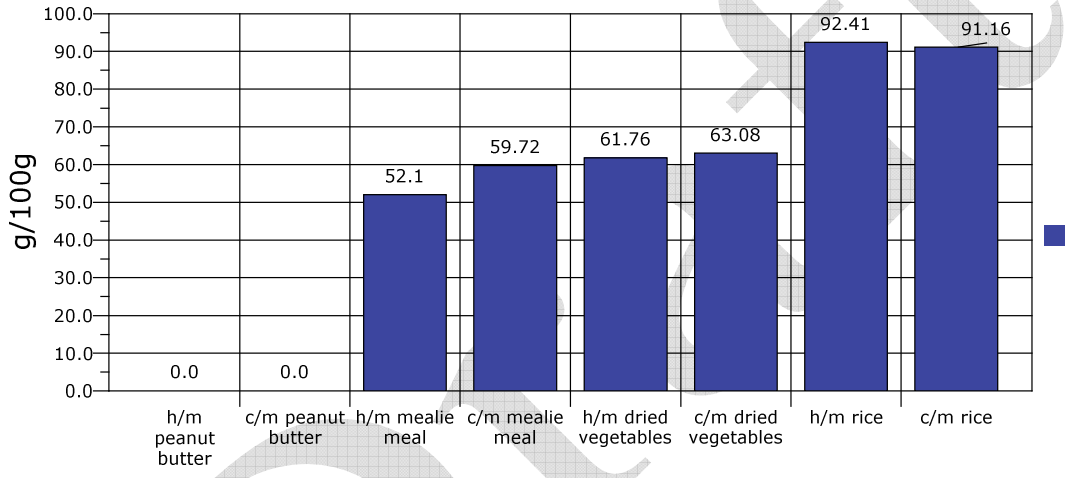

Fig. 3 Results of carbohydrate analysis

From the fig.3 it can be deduced that most endogenously processed products, with the exception of rice, have a lower carbohydrate value than commercially processed food. The analysis showed that there were insignificant amounts of carbohydrates in both peanut butter samples. Commercially processed mealie-meal had a carbohydrate content of 59.72 g/100g which is higher than that of home-made mealie-meal that showed a carbohydrate content of 51.21 g/100g. According to the Food and Nutrition Board, Institute of Medicine, National Academics (2002), the EAR value for

carbohydrates for females aged 51 years and above is 100g per day.

From the surveys in this study, carbohydrate daily intakes among the respondents also appeared generally adequate. Comparatively, Marais, Marais and Labadoris (2007) also observed similar trend that from their studies on South African elderly women aged 60 years and beyond, 71.7 percent met the EAR value for carbohydrates (Marais et al. 2007:104).

5.5 Energy results

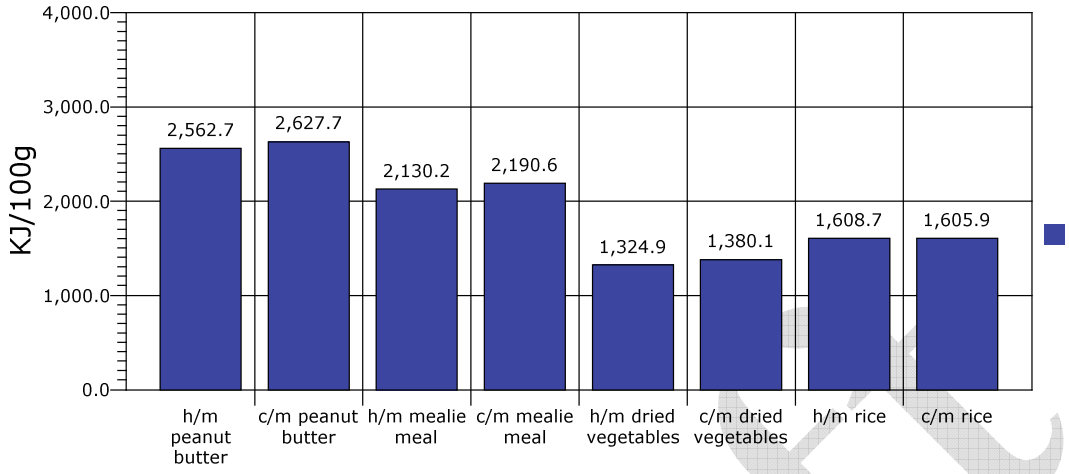

Fig. 4 Results of energy analysis

As illustrated in Fig 4, the general trend was that commercially processed food had higher energy values than homemade food. Endogenously processed mealie-meal and dried vegetables had lower energy values of 2130.2 and 1324.9 KJ/100g, respectively than commercially made mealie-meal, dried vegetables and rice which had values of 2190.6 and 1380.1 KJ/100g, respectively. This can be attributed to higher fat and carbohydrate values recorded in commercially processed foods which are more refined.

5.6 Vitamin C results

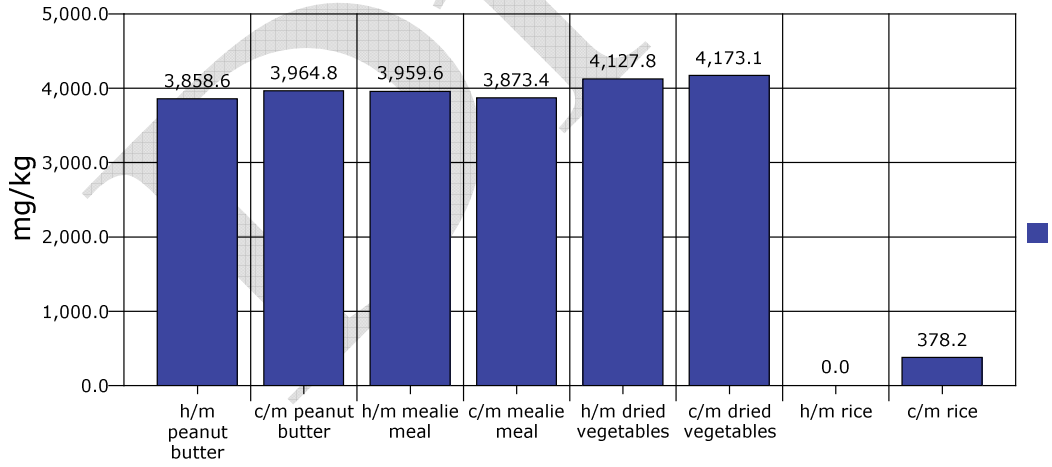

Fig. 5 Results of Vitamin C analysis

Vitamin C is also called L-ascorbic acid but other isomers also exist (Chavez-Servin 2007). Processing and cooking conditions such as high temperatures, high pH, and the presence of transition metals and oxidising agents cause vitamin C loss, with the loss varying widely according to the processing method and type of food (Leskova 2005). Figure 5 shows that, generally, endogenously processed foods have lower vitamin C content, with the exception of mealie-meal.

This can be attributed to the sound application of food science such as the use of antioxidants by commercial food manufacturers. More particularly, was the example of the antioxidants butylated hydroxytoluene (BHC) and TBHQ often added to commercially made dried vegetables aiding in the preservation of vitamin C.

Home-made mealie-meal, however, had a higher vitamin C content of 3959.6mg/kg than the commercially processed mealie-meal which had a vitamin C content of 3873.4 mg/kg. This is due to the fact that the whole grain is used in home-made mealie-meal unlike in commercially processed mealie-meal which is refined, to some extent, with the outer seed coat removed. The Food and Nutrition Board, Institute of Medicine, National Academics (2002), states that the EAR value for vitamin C for females aged 51 years and above is 60mg per day hence only a small portion size of the endogenously processed foods is required to adequately meet the requirements for vitamin C. The advantage of higher vitamin C content in commercially processed foods hence consequently becomes overshadowed.

5.7 Crude fibre results

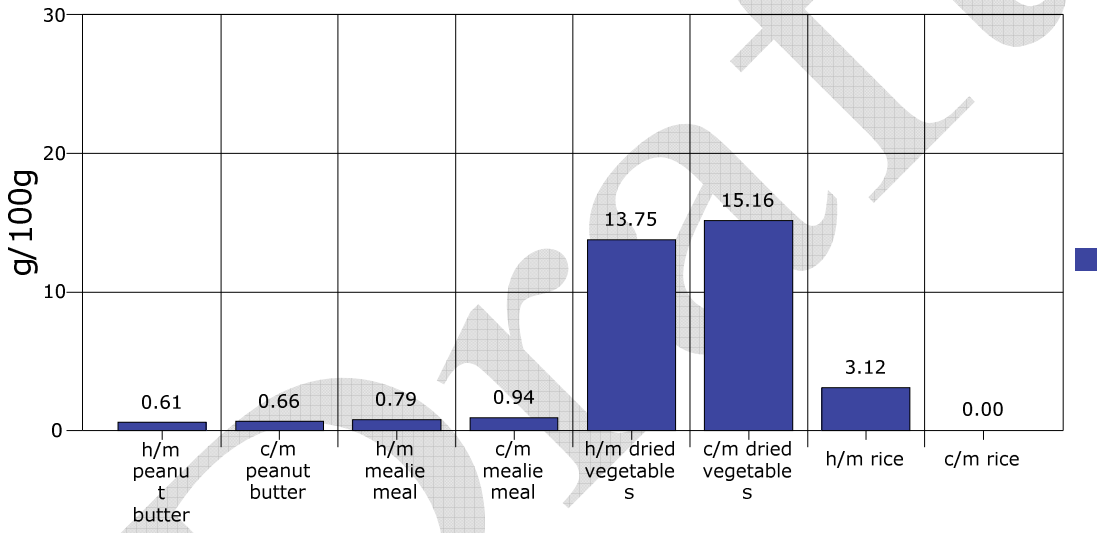

Fig. 6 Results of crude fibre analysis

Crude fibre is of low digestibility and is composed of cellulose, hemi cellulose and some lignins (Alajaji and El-Adawy 2006). A considerable amount of scientific data supports the positive effects of dietary crude fibre on reducing blood cholesterol levels, regulating bowel movement and stabilising blood sugar levels (Lee et. al 2007). From the data in Figure 6, it can be noted that with the exception of rice, all commercially processed food products have higher crude fibre values. Home-made peanut butter, mealie-meal and dried vegetables had lower crude fibre values of 0.61g/100g, 0.79g/100g and 0.94g/100g, respectively than the commercially made peanut butter, mealie-meal and dried vegetables which had values of 0.66 g/100g, 0.94 g/100g and 15.16 g/100g, respectively. This is largely attributable to the fillers such as bran which contains a lot of crude fibre that the commercial producers add to their products as stabilisers (Hopwood, 1999).

This is evidenced by the fact that since rice is not comminuted, no filler or adulterant can be added. Hence home-made rice has higher crude fibre value of 3.12 g/100g than the commercially processed rice

which is normally polished removing all the bran such that it contains no detectable crude fibre. According to the Food and Nutrition Board, Institute of Medicine, National Academics (2002), the total crude fibre adequate Intake values for females aged 51 and above is 21g/day. Marais et. al (2007) indicated that from their studies on elderly women in South Africa, 98.2 percent met this value, hence a greater number of the elderly women consume sufficient fibre in their diet (Marais et al., 2007:104).

5.8 Ash results

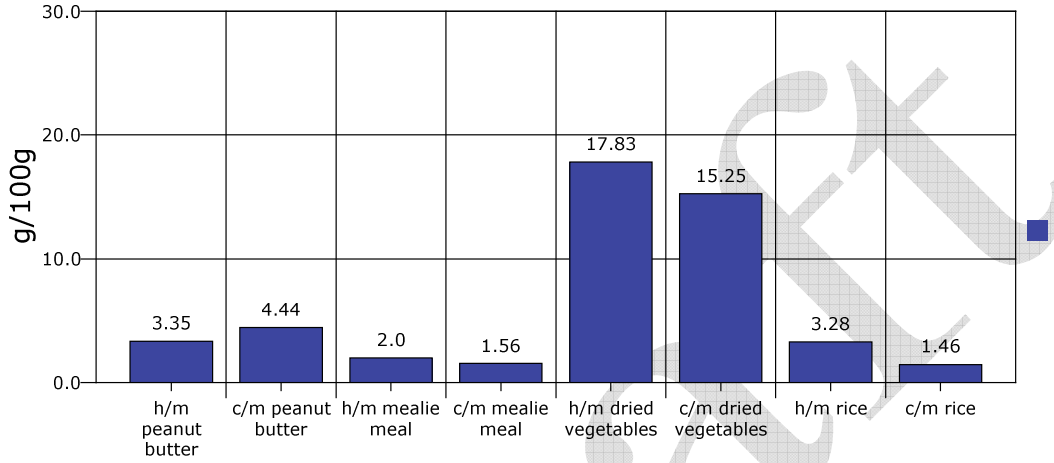

Fig. 7 Results of ash analysis

According to Figure 7, the general trend is that endogenously processed food products contain more ash than commercially processed food products with the exception of peanut butter. Home-made processed mealie-meal, dried vegetables and rice contained higher ash values of 2.00 g/100g, 17.83 g/100g, and 3.28 g/100g respectively than commercially processed mealie- meal, dried vegetables and rice with values of 1.56 g/100g, 15.25 g/100g and 1.46 g/100g, respectively. The ash figure is directly proportional to the total mineral content in a food product. This alludes that home-made processed foods have a higher mineral content than commercially processed products hence are healthier.

5.9 Zinc and copper results

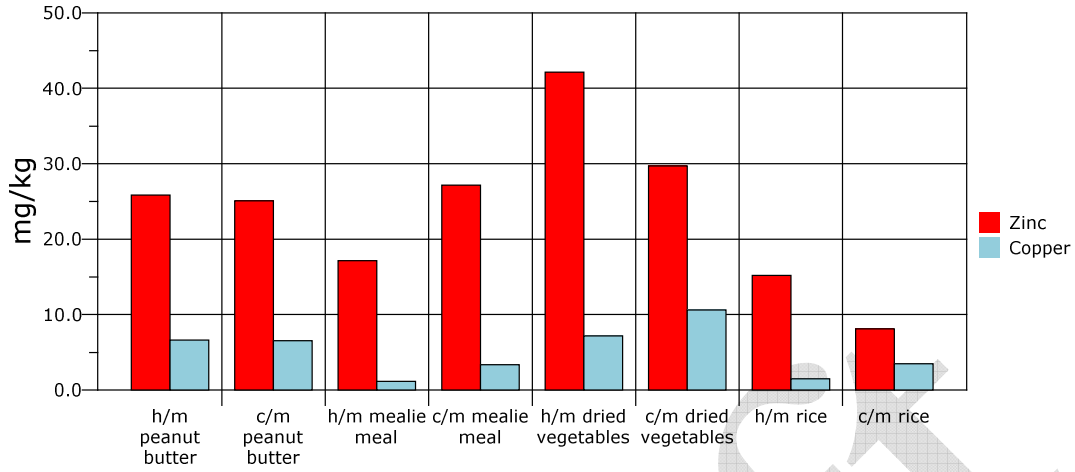

Fig. 8 Results of zinc and copper analysis

Figure 8 indicates that, generally, endogenously processed foods contain more zinc than commercially processed foods. Zinc is needed in greater quantities due to its poor bio-availability (Abebe 2006), as it was discovered that phytic acid, a dietary factor found mainly in unrefined (home-made processed) cereals and legumes potentially inhibits the assimilation of zinc (Chan et. al 2007).

The Food and Nutrition Board, Institute of Medicine, National Academics (NAS 2004) indicates that the EARs for zinc for females aged 51years and above is 68 micrograms per day. According to a study of elderly South African women by Marais et al. (2007), elderly women above 60 years of age obtain high amounts of zinc per day, with an average of 129.3 percent of the EAR (Marais et al. 2007:104).

All the endogenously processed food samples, unlike the commercially processed foods, are above this figure per kilogram of the food, and thus are more acceptable and recommended. The copper content of food is of great concern to patients suffering from Wilson's disease, characterised by excess copper deposition in many organs such as the liver, brain and kidneys (Verissimo et. al 2005) hence it needs to be regulated to low amounts in their diet.

Endogenously processed peanut butter, dried vegetables and rice had higher zinc content values of 25.85, 42.13 and 15.20mg/kg, respectively than commercially processed peanut butter, dried vegetables and rice which had values of 25.06, 29.70 and 8.10mg/kg, respectively. The prevalence of high levels of zinc in home-made products can be attributed to the lower levels of processing applied in home-made food manufacture.

In contrast to the trends for zinc values most home-made products had lower copper levels than commercially made product Copper is an essential element for the human body but illness can occur when the diet is copper deficient or in cases of excessive intake (Verissimo et. al 2005). Commercially made mealie-meal, dried vegetables and rice had higher copper values of 3.34, 10.59 and 3.50 mg/kg, respectively than the endogenously processed mealie-meal, dried vegetables and rice with values of 1.15, 7.21 and 1.48mg/kg, respectively. Studies during the past decade indicate that zinc and iron deficiencies usually coexist globally hence foods containing potentially moderate to high levels of zinc and iron are highly recommended (Karunaratne et, al 2008).

5.10 Iron and Magnesium results

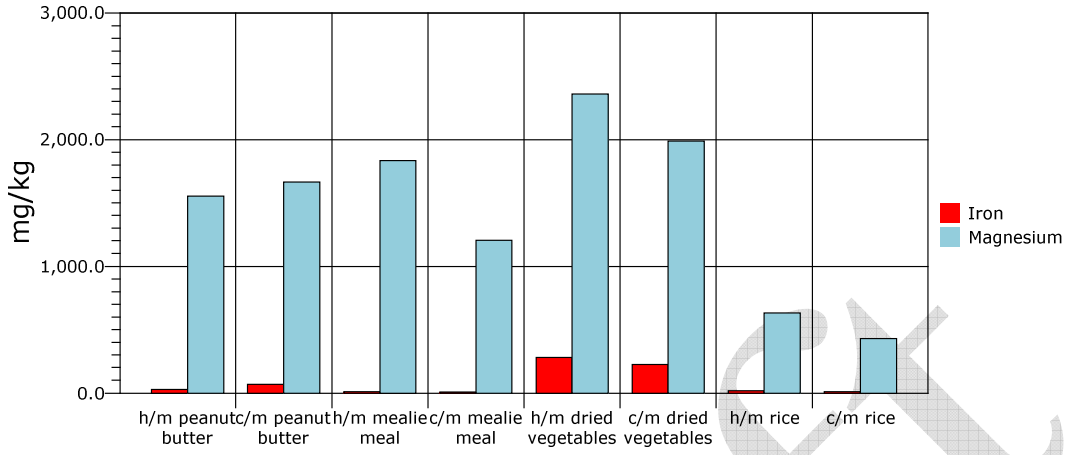

Fig. 9 Results of iron and magnesium analysis

Iron deficiency is a serious health problem affecting a large proportion of the world's population (MacPhail and Bothwell 1992). Figure 9 reveals that most endogenously processed products contained more iron than the commercially processed foods. Respectively, endogenously processed mealie-meal, dried vegetables and rice contained higher iron contents of 10.00, 279.84 and 18.03 mg/kg than commercially processed mealie-meal, dried vegetables and rice which, respectively, had values of 8.98, 277.12 and 10.58 mg/kg. Magnesium is an essential nutrient for the human body, which has been identified as an enzymatic co-factor of more than 300 enzymatic reactions related to the whole of corporal metabolism (Jodral-Segado, 2003). The results of analysis show that most endogenously processed foods had higher magnesium content than commercially processed foods. Endogenously processed mealie-meal, dried vegetables and rice all had a higher magnesium content of 1850.00, 2362.17 and 632.95 mg/kg than commercially processed mealie-meal, dried vegetables and rice which had values of 1207.03, 1989.16 and 430.66 mg/kg.

5.11 Moisture results

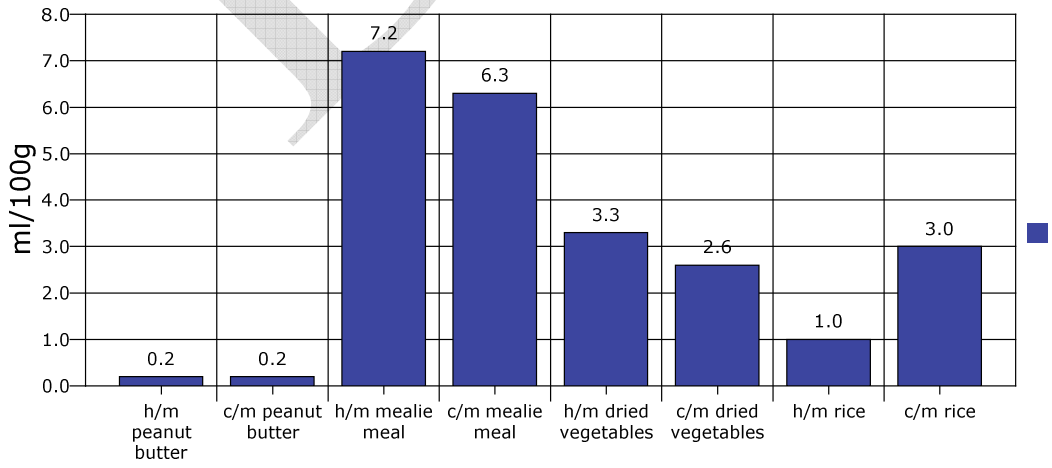

Fig. 10 Results of moisture analysis

Moisture availability is a fundamental principle in food preservation and the food processing technique applied has an overwhelming effect on the moisture content of the processed foodstuffs (Vittadini et. al 2004). The higher the water content of a foodstuff per gram, the lower the nutrient density of the foodstuff per gram of the foodstuff. Graph 10 indicates that, generally, endogenously processed foods contain higher moisture levels. Both traditionally and commercially processed peanut butter had moisture contents of 0.2 ml/100g and endogenously processed mealie-meal and dried vegetables had higher moisture contents of 7.2 ml/100g and 3.3 ml/100g, respectively than commercially processed mealie-meal and dried vegetables with values of 6.3 ml/100g and 2.6 ml/100g, respectively.

The moisture content of packaged food depends on a number of different factors such as the type and quality of packaging material. In this regard, the researcher observed that commercially processed food have superior quality of packaging material in most cases. Commercially processed dried vegetables have lower moisture content because of the more effective artificial drying methods as compared to the sun drying method applied by home-made dried vegetable processors. Products with lower moisture content, however, have better keeping qualities and higher microbiological stability.

6. Conclusions

The purpose of this study was to evaluate the role and importance of endogenously processed foods in relation to commercially processed foods, emphasising on the strengths and weaknesses between the two concepts in respect of nutritional value. The overall results indicate that both methods of food processing have some advantages and disadvantages over each other as far as health implications are concerned.

It can, however, be concluded that endogenously processed foods are better and healthier than commercially processed foods based on a nutritional point of view. This was proven by the fact that endogenously processed foods are richer in critical micronutrients such as iron, zinc and magnesium. The traditional foods are also richer in terms of total micronutrient content as shown by the significantly higher ash values recorded from the results of chemical analysis.

According to the results, endogenously processed foods were generally higher in protein and hence are advantageous as the human body has a high demand for protein which has little or no adverse conditions if available in large quantities in the diet. Endogenously processed foods are also advantageous as they generally contain less fat and energy comparing with commercially processed foods whose consumption increases the risk of obesity and development of cardiovascular diseases.

Based on the results of chemical analysis, commercially processed foods do, nonetheless, display higher vitamin C and crude fibre contents, which can be attributed to food additives such as antioxidants like TBHQ and various stabilisers and fillers usually added to commercially processed foods, whose impact on health are yet to be accurately determined. It can therefore be recommended to consume more endogenously processed foods than commercially processed foods.

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