

## NUTRITIONAL SCIENCE

# Nutritional composition of commonly consumed composite dishes from rural villages in Empangeni, KwaZulu-Natal, South Africa

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### Abstract

**Background:** Accurate nutrient composition data for composite dishes unique to a population is essential for the development of a nutrient database and the calculation of dietary intake. The present study aimed to provide the nutritional composition of composite dishes frequently consumed in rural KwaZulu-Natal, South Africa.

**Methods:** Commonly consumed composite dishes were identified using 24-h recalls collected from 79 randomly selected community members. Multiple recipes were collected for each reported dish. The mean nutritional composition of each dish was calculated per 100 g using the NUTRIBASE CLINICAL NUTRITION MANAGER (Cybersoft Inc., Phoenix, AZ, USA).

**Results:** A total of 79 recipes were collected for 16 commonly consumed dishes (seven meat-based, five starch-based and four legume/vegetable-based). 'Fried chicken' contained the most energy [1469 kJ (351 kcal)], protein (29.7 g), fat (23.7 g), cholesterol (123 mg) and niacin (8.4 mg). 'Fried beef' contained the most potassium (495 mg) and zinc (6.4 mg), whereas 'fish stew' had the most vitamin D (4.2 µg) and calcium (215 mg). 'Fried cabbage' and 'fried spinach' contained the largest percent energies from fat, at 79% and 76%, respectively. A traditional sweet bread, 'jeqe', made with fortified flour contributed significantly to iron (4.6 mg), niacin (4.5 µg) and folate (129 µg). The sodium content of dishes ranged from 88 to 679 mg per 100 g.

**Conclusions:** The nutritional composition data for commonly consumed dishes in rural KwaZulu-Natal is presented. Although the dishes are good sources of protein, vitamins and minerals, they also contain substantial amounts of fat. This culturally appropriate information will enable the calculation of dietary intake and can be used to encourage the consumption of recipes rich in key nutrients.

### Introduction

Nutrition-related noncommunicable diseases (NR-NCDs) used to be most prevalent in higher income countries; however, their prevalence is rapidly increasing in lower and middle income countries worldwide (Popkin, 2006). This is a result of globalisation and urbanisation (Popkin, 2009) leading to a shift in diet characterised by increased

intakes of fat and animal protein, decreased intakes of carbohydrates and dietary fibre, and suboptimal micronutrient intakes (Pieters & Vorster, 2008). This lifestyle change is also associated with decreased energy expenditure (Bourne *et al.*, 2002). Nutrition-related noncommunicable diseases are becoming an increasing problem in South Africa. In 2003, 55% of women and 30% of men over 15 years of age were overweight or obese

(Department of Health Medical Research Council, 2007). Although no national prevalence statistics for diabetes are currently available in South Africa, a number of epidemiological studies have been conducted in selected communities and, based on available data, the prevalence of diabetes in South Africa is estimated to be 1–1.5 million (Bradshaw *et al.*, 2007). The total South African population is estimated to be 50.58 million (Statistics South Africa, 2011). The burden of noncommunicable diseases is rising in rural communities (Househam, 2010). A study aimed at determining the prevalence and risk factors of cardiovascular disease (CVD) in a rural adult black population in South Africa found that significant risk factors did exist and, from these, predicted that 18.9% of women and 32.1% of men had a >20% chance of having a CVD event in the next 10 years (Alberts *et al.*, 2005).

Replacement of traditional foods with nonnutrient energy-dense foods, large portion sizes, cheap food options and limited food variety are all factors contributing to the increasing prevalence of noncommunicable diseases in South Africa (Vorster *et al.*, 2005).

Zulu peoples are the largest South African ethnic group, most of who live in the province of KwaZulu-Natal (KZN), located in southeast South Africa. KwaZulu-Natal has an area of 94 361 square kilometers and a population of 10.6 million people (Statistics South Africa, 2010). A recent study characterising global dietary habits related to chronic disease identified South Africa as a country where there is a gap of current knowledge on diet-disease relations (Micha *et al.*, 2011). Two barriers to assess diet-related chronic disease in this population are the limited data on the nutritional composition of composite dishes consumed and the dietary habits of this rural population.

The present study aimed to provide the nutritional composition of 16 composite dishes frequently consumed in rural Empangeni, KZN, South Africa. This information is essential to further assess the nutrient intake in this population. These data will be useful for developing dietary interventions, including nutritional education necessary for dietary management of NR-NCDs such as diabetes, obesity and CVD.

## Materials and methods

The present study was conducted in rural villages surrounding Empangeni, KZN, South Africa. Empangeni is located 160 km north of Durban (the capital of KZN), and is within the local municipality of UMhlatuze, which has a rural population of 185 581 people (Statistics South Africa, 2001). Participants from villages surrounding Empangeni were randomly notified of the study by a community liaison. Everyone in the surrounding commu-

nities was of the same socioeconomic status, living in rondavels. Only men ( $n = 34$ ) and women ( $n = 45$ ) who were the main food preparers and shoppers for their household were interviewed. Data were collected in June, 2011, and the methodology for the collection and analysis of composite dishes has been described in detail previously (Sharma *et al.*, 2007a,b; Sharma, 2011). In brief, 24-h recalls were collected from 79 community members and were conducted by locally trained field staff. Training took place at Izulu Orphan Projects (IOP) charity, and included practice interviews on IOP staff. Fieldworkers were trained by the principal investigator (SS) and supervised during data collection (by NM). The interviews were conducted in community centres in the villages, and systematically sought and recorded information about foods and drinks consumed during the preceding 24-h period. To accurately estimate portion size, interviewers used familiar household units such as a cup, spoon and plate, standard units such as a slice of bread, and culturally-appropriate three-dimensional models (Nasco Food Models, Fort Atkinson, WI, USA).

The commonly consumed composite dishes for our analyses were chosen from the foods reported on the 24-h recalls. To obtain the food composition data for these dishes, local field workers were trained on site by the principal investigator, on how to collect, record and weigh ingredients, as well as report the final cooked weight. Six community members were randomly chosen to cook the 16 composite dishes. Each dish was prepared five times and, to ensure variety within each dish, no community member prepared the same dish more than once. The field workers recorded weights of ingredients and the final cooked weight for every cooked dish ( $n = 80$ ). For foods such as onions, only the edible portion after preparation was weighed (e.g. weight after removal of the peel). All food weights were measured using electronic kitchen scales (Aquatronic Baker's Dream Scale; Salter Houseware, Ltd, Tonbridge, UK).

A mean of the individual ingredient weights and final cooked weights of each of the five recipes for all dishes was taken to determine a 'final' recipe for each dish. The 'final' recipes for each dish were entered into the nutritional database, NUTRIBASE CLINICAL NUTRITION MANAGER, version 9 (Cybersoft Inc., Phoenix, AZ, USA), a computerised dietary database based on the US Department of Agriculture (USDA) National Nutrient Database for Standard Reference because the food composition database for South Africa is limited in the number of foods and nutrients. The USDA database provides a complete nutrient profile (63 nutrients) for 7906 foods (US Department of Agriculture, Agricultural Research Service, 2008), as opposed to the South Africa database, which only provides five nutrients per food item (Medical Research

Council of South Africa, 2010). The nutritional composition of the 'final' recipes is given per 100 g.

The present study was approved by the Research Ethics Board of the University of Alberta and the University of KZN.

## Results

Data were collected in the form of 24-h recalls from 35 men and 44 women living in the rural communities of Empangeni, KZN. The mean (SD) age for men and women was 44.0 (17.4) years and 49.6 (15.2) years, respectively. There were 16 frequently reported composite dishes traditional to rural Empangeni, KZN, for which, to our knowledge, there were no available nutrient composition data.

A description of the 16 composite dishes is presented in Table 1. Seven of the composite dish contained meat, of which three contained beef, three contained chicken and one contained fish. Of the remaining nine dishes, five were starch-based, two contained legumes, and two included only vegetables.

Tables 2 and 3 present the nutritional composition per 100 g of meat-based and plant-based dishes. Among the 16 dishes, 'fried chicken,' 'fish stew' and 'fried beef' contained the highest amounts of energy at 1469 kJ (351 kcal), 1008 kJ (241 kcal) and 904 kJ (216 kcal), respectively. 'Fried chicken' contained the most protein (29.7 g), fat (23.7 g), cholesterol (123 mg) and niacin (8.4 mg). 'Fried beef' contained the most potassium (495 mg) and zinc (6.4 mg), whereas 'fish stew' had the highest content of vitamin D (4.2 µg) and calcium (215 mg).

Of all the dishes, 'fried cabbage' and 'fried spinach' contained the largest percent energy from fat, at 79% and 76%, respectively, as a result of the large amount of vegetable oil used for frying. 'Fried spinach' also had the highest vitamin A (293 µg) and vitamin C (34 mg) of all the dishes. 'Fried beans' contained the most total folate (149 µg) and potassium (658 mg). A traditional sweet bread called 'jeqe', made with fortified white flour and sugar, contributed significantly to total folate (129 µg), niacin (4.5 mg) and iron (4.5 mg), and contained the most energy of all the vegetable and grain dishes 1134 kJ (271 kcal). Overall, the sodium content of all 16 dishes ranged from 88 mg in 'stifpap', to 679 mg in 'fried spinach'.

## Discussion

To our knowledge, this is the first time that weighed recipes representing the most commonly consumed dishes in the rural communities of Empangeni, KZN, have been collected. We provide a comprehensive nutritional breakdown of the composite dishes for this study population. Evaluating the nutritional composition of these dishes is of critical importance for calculating daily nutrient intakes at the population level (Greenfield & Southgate, 2003) and to be able to facilitate future nutrition interventions that are population-specific (Sharma, 2011). This information can be used to develop culturally appropriate food-based dietary guidelines.

Overall, we identified 16 composite dishes in this community. Among these, 'fried chicken' and 'fish stew' had the highest amount of energy. Most of the dishes were

**Table 1** Description of the commonly consumed composite dishes in rural KwaZulu-Natal, South Africa

Dish	Ingredients
<b>Meat-based</b>	
Fried beef	Beef, oil, tomatoes, onions, and salt
Beef soup	Beef, water, and salt
Beef stew	Beef, potatoes, tomatoes, onion, water, and salt
Fried chicken	Chicken with skin, oil, onion, and salt
Chicken soup	Chicken, water, and salt
Chicken stew	Chicken, tomatoes, onion, water, salt, curry powder, and garlic
Fish stew	Canned fish (sardines) in tomato sauce, onions, tomatoes, curry powder, and salt
<b>Starch-based</b>	
Dumplings	Dough made with white flour, water, and salt, served in chicken or beef soup
Jeqe	White flour, yeast, baking powder, and sugar
Putu	Refined maize meal, water, and salt
Potatoes	Potatoes, water, oil, onion, salt, curry powder, and tomatoes
Stifpap	Refined maize meal, water, and salt (it is traditionally eaten as a breakfast food)
<b>Legumes/vegetable-based</b>	
Beans	Red-speckled sugar beans, oil, salt, and onions
Samp and beans	Red-speckled sugar beans, oil, salt and onions served with refined maize
Fried spinach	Swiss chard, oil, onion, salt, and tomatoes
Fried cabbage	Cabbage, oil, onion, and salt

**Table 2** Nutritional composition\* of seven commonly consumed meat and fish composite dishes<sup>†</sup> in rural KwaZulu-Natal, South Africa

	Fried beef	Beef soup	Beef stew	Fried chicken	Chicken soup	Chicken stew	Fish stew
Energy [kJ (kcal)]	904 (216)	251 (60)	586 (140)	1469 (351)	343 (82)	669 (160)	1008 (241)
% Energy from protein	47	68	31	34	49	44	31
% Energy from carbohydrate	5	0.5	17	4	1	7	4
% Energy from fat	47	31.5	52	62	50	49	65
Protein (g)	26	10	11	30	10	17	18
Carbohydrate (g)	2.9	0.1	6.2	3.1	0.3	2.9	2.6
Fat (g)	12	2	8	24	4	8	17
Saturated fat (g)	3.1	0.9	1.7	5.0	1.2	2.2	3.4
Monounsaturated fat (g)	5.7	1.1	3.9	10.0	1.7	3.3	7.9
Polyunsaturated fat (g)	2.6	0.1	2.4	6.8	1.0	2.0	4.8
Omega-3 fatty acid (g)	0.01	0	0	0.09	0.03	0.05	1.26
Omega-6 fatty acid (g)	0.28	0.11	0.11	0	0	0	0
Sugars (g)	1.3	0	1.6	1.5	0.1	1.3	1.4
Dietary fibre (g)	0.6	0	1.3	0.6	0.1	0.8	0.7
Cholesterol (mg)	75	30	30	123	41	70	53
Vitamin A (µg-RAE)	8	1	57	47	25	36	37
Thiamin (mg)	0.11	0.04	0.07	0.13	0.04	0.08	0.05
Riboflavin (mg)	0.21	0.08	0.1	0.28	0.09	0.17	0.21
Niacin (mg)	5.9	2.3	2.8	8.4	2.8	4.9	3.8
Pantothenic acid (mg)	0.8	0.3	0.4	1.8	0.6	1.1	0.7
Vitamin B <sub>6</sub> (mg)	0.7	0.3	0.4	0.5	0.2	0.3	0.1
Total folate (µg)	10	1	12	21	5	15	27
Vitamin B <sub>12</sub> (µg)	2.7	1.1	1.1	0.5	0.2	0.3	7.8
Vitamin C (mg)	4	0	8	7	2	7	4
Vitamin D (IU)	4.7	1.9	1.9	4.6	1.5	2.6	167.2
Vitamin E (IU)	0	0	0	0	0	0	0
Calcium (mg)	25	10	19	27	8	21	215
Magnesium (mg)	29	11	20	37	12	25	34
Potassium (mg)	495	171	354	374	113	273	362
Sodium (mg)	403	314	274	628	202	466	570
Selenium (µg)	28	11	12	20	7	12	35
Iron (mg)	2.6	1.0	1.3	1.7	0.5	1.2	2.2
Zinc (mg)	6.4	2.6	2.7	3.1	1.0	1.8	1.3

\*Nutritional composition reported per 100 g.

<sup>†</sup>Number of weighed recipes for each dish was five.

IU, international units; RAE, retinol activity equivalents.

fried in oil, resulting in a significant contribution of fat to the total energy. This is a finding similar to that found among fried foods in other cultures (Sharma *et al.*, 2007a,b, 2008). A study on the nutritional composition of composite dishes from Barbados found a high fat content in many dishes, including pumpkin fritters, fried giblets, fried flying fish and sautéed corn beef (Sharma *et al.*, 2007a). An alternative method of cooking should be considered as a key strategy in the development of a dietary intervention in this community. It is well known that foods fried in hydrogenated vegetable oils contain trans fatty acids (TFA), and the ingestion of TFA is linked to poor cardiovascular health (Motard-Belanger *et al.*, 2008). Previous studies show that, in the past 50 years, fat intake has increased from 16.4% to 26.2% of total energy among urban blacks in South Africa (Bourne *et al.*, 2002). Major

increases in domestic production and imports of vegetable oils are having substantial effects on fat intake worldwide. The global availability of oils has approximately tripled between the years 1961 and 1990, and the impact is especially significant in developing countries (Popkin & Gordon-Larsen, 2004).

We found few of the composite dishes contributed significant amounts of zinc and iron, with the exception of 'fried beef', which also contained a large amount of fat. The food supply in sub-Saharan Africa provides only approximately 55% of the normative population dietary zinc requirement, and 68–95% of the population is at risk for low zinc intake. Zinc is especially important for physical growth, reducing the susceptibility to infection, as well as pregnancy and neurobehavioural development (Brown *et al.*, 2001).

**Table 3** Calculated nutritional composition\* of nine commonly consumed vegetable and grain composite dishes† in rural KwaZulu-Natal, South Africa

	Dumpling	Jeqe	Putu	Potatoes	Beans	Samp & beans	Fried spinach	Fried cabbage	Stifpaap
Energy [kJ (kcal)]	858 (205)	1134 (271)	841 (201)	515 (123)	728 (174)	473 (113)	715 (171)	761 (182)	322 (77)
% Energy from protein	10	8	8	6	18	18	5	3.5	8
% Energy from carbohydrate	88	83	88	51	55	79	19	18	86
% Energy from fat	2	9	4	43	27	3	76	78.5	6
Protein (g)	5	5	4	2	8	5	2	2	2
Carbohydrate (g)	44	55	43	16	25	22	8	8	16
Fat (g)	0.5	2.7	1.0	6.0	5.2	0.4	15.3	16.6	0.5
Saturated fat (g)	0.1	0.4	0.1	0.8	0.7	0.1	2	2.2	0.1
Monounsaturated fat (g)	0.1	1.1	0.2	2.7	2.3	0.1	7.0	7.6	0.1
Polysaturated fat (g)	0.2	1.0	0.3	2.2	1.9	0.1	5.5	6.1	0.2
Omega-3 fatty acid (g)	0	0	0	0	0	0	0	0	0
Omega-6 fatty acid (g)	0	0	0	0	0	0	0	0	0
Sugars (g)	0.3	6.5	0.9	1.8	3.7	1.9	3.4	4.4	0.3
Dietary fiber (g)	1.0	1.2	2.1	2.8	7.3	4.3	2.5	3.3	0.8
Cholesterol (mg)	0	0	0	0	0	0	0	0.01	0
Vitamin A ( $\mu$ g-RAE)	0	0	0	6.2	0	0	293	36.8	1.7
Thiamin (mg)	0.5	0.62	0.3	0.08	0.19	0.17	0.06	0.08	0.11
Riboflavin (mg)	0.24	0.29	0.21	0.04	0.08	0.09	0.1	0.05	0.08
Niacin (mg)	3.8	4.5	2.7	1.1	0.6	0.9	0.6	0.3	1.0
Pantothenic acid (mg)	0.3	0.4	0.1	0.3	0.5	0.3	0.2	0.3	0.1
Vitamin B <sub>6</sub> (mg)	0.02	0.03	0.1	0.22	0.2	0.13	0.16	0.19	0.05
Total folate ( $\mu$ g)	105	129	114	22	149	105	25	52	43
Vitamin B <sub>12</sub> ( $\mu$ g)	0	0	0	0	0	0	0	0.08	0.02
Vitamin C (mg)	0	0	0	20	1	0	34	42	0
Vitamin D (IU)	0	0	0	0	0	0	0	3.1	0.9
Vitamin E (IU)	0	0	0	0	0	0	0	0	0
Calcium (mg)	85	42	4	19	43	21	60	52	4
Magnesium (mg)	10	11	18	25	88	51	82	17	8
Potassium (mg)	59	71	77	428	658	364	469	233	29
Sodium (mg)	128	215	91	520	259	100	679	304	88
Selenium ( $\mu$ g)	2.8	3.1	5.7	0.5	2.7	2.7	1.0	0.5	2.2
Iron (mg)	4.2	4.6	2.4	0.8	2.8	2.0	1.8	0.7	0.9
Zinc (mg)	0.4	0.4	0.4	0.4	1.1	0.7	0.5	0.3	0.1

\*Nutritional composition reported per 100 g.

†Number of weighed recipes for each dish was five, except for 'samp and beans' which only had four. IU, international units; RAE, retinol activity equivalents.

Our data show that considerable amounts of salt are usually added during the cooking process, and, consequently, most of the dishes contained large amounts of sodium. The daily recommended intake of sodium is 1500 mg (National Academy of Sciences, 2005) and excess dietary sodium intake is known to cause hormonal and cellular responses in the body, leading to a range of disorders, including high blood pressure and an associated increased risk of stroke, coronary heart disease and heart failure (Sanchez-Castillo & James, 2005).

Our results showed that the only dish containing a large amount of calcium and vitamin D was 'fish stew'. The only other dish with notable calcium content was 'dumplings', resulting from the fortified flour used. Food sources of calcium are minimal in South Africa and the diets also contain high amounts of phytates, oxalates and tannins that reduce calcium absorption. Low dietary calcium has also been identified as a possible contributing factor to ricket-like bone deformities in children without apparent vitamin D deficiency in South Africa, because limited calcium in the diet has negative effects on vitamin D metabolism (Prentice *et al.*, 2009).

Vitamin A is most bioavailable in foods from animal sources; however, in the present study 'fried spinach' contained the most vitamin A of all the dishes. Vitamin A deficiency is prevalent in most developing countries, with the highest prevalence of deficiency in Southeast Asia and Africa. Vitamin A is essential for healthy growth and survival in humans, and has been linked to many aspects of good health, including immune function and eye health (Faber & Laurie, 2011).

Direct analysis of composite foods is the most precise method to produce nutrient values; however, this was beyond the scope and resources of the present study. Collecting weighed recipes to determine the calculated nutritional composition was an alternative method of choice. Research comparing the two methods reported positive correlations, especially for macronutrient data, and a substantial number of studies use this weighted method (Sharma *et al.*, 2007a,b, 2008, 2009; Ramdath *et al.*, 2011). Minor variations in vitamin values may have occurred because we were unable to account for vitamin losses that could have occurred during cooking. Slight variations in nutrient content of some foods may have also occurred as a result of variations in food composition data. South Africa has very limited food composition data and the nutrient list in USDA is more complete. The USDA food composition tables contain data for more than 130 nutrients for over 7000 foods and ingredients (US Department of Agriculture, Agricultural Research Service, 2011). This database has also been shown to produce nutrient compositions that are highly correlated with data collected from direct chemical analysis (Merchant & Dehghan, 2006). We

recognise that using a USA food database to calculate the nutritional composition of South African dishes has its limitations. Exact food matches could not always be found in the USDA database, and we were also unable to account for the difference in soil content, animal feeding practices, grain enrichment and food fortification between the USA and South Africa.

A calculated nutritional composition of composite dishes was necessary, and this information provides an essential foundation for defining mean daily nutrient intakes, and determining long-term dietary assessment in the study population, as well as for cross-cultural comparison studies.

## Conclusions

We have provided the nutritional composition of 16 composite dishes frequently consumed in rural Empanjeni, KZN, South Africa. The results suggest that these dishes are good sources of protein, vitamins and minerals; however, they also contained substantial amounts of fat. It is hoped that this baseline data will be used by health-care professionals to develop dietary intervention strategies for fat reduction in this community, by the promotion of alternate cooking methods to produce lower-fat traditional versions of commonly consumed composite dishes. This up-to-date and culturally appropriate information will enable the calculation of accurate energy and nutrient intakes for the Zulu peoples of Empanjeni, and should be used to encourage the consumption of recipes containing key macro- and micronutrients.

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KS was responsible for data collection, data input, data analysis, and wrote the first draft of the manuscript. FK provided assistance with data analysis and helped write the manuscript. ML helped write the manuscript. NM and TK contributed to the reviewing and editing of the manuscript. SS conceived the study, oversaw the project and contributed to the reviewing and editing of the manuscript. All authors have critically reviewed the manuscript, and have approved the final version for submission and publication.

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