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DEVELOPMENT, CHARACTERIZATION AND EVALUATION OF HIGH ENERGY BISCUITS FOR COMBATING MALNOURISHMENT AMONG CHILDREN IN PAKISTAN

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ABSTRACT:- The study was conducted to prepare supplemented biscuits which could be used as nutritive snacks for malnourished children. Biscuits were prepared by supplementing chickpea and oat in patent flour (fine flour) with different ratio (5%, 10%, 15% and 20 %). Biscuits with no supplementation were kept as control treatment. Chemical and sensory evaluation of supplemented biscuits was carried out. An increase in nutritive values have been observed with an increase in supplementation level. Proximate analysis shows that T_7 and T_8 get the highest values for protein, zinc and iron. Results of all treatments were in acceptable range regarding sensory evaluation. These results indicate that biscuits can be successfully supplemented with chickpea and oat. According to sensory evaluation, biscuits containing 20% chickpea and 15% oat were found to be the best among all treatments and could be a potential composition for preparing high energy biscuits for malnourished areas of Pakistan.

Key Words: Malnutrition; Children; Biscuits; Chemical; Sensory Evaluation; Pakistan.

INTRODUCTION

Malnutrition is a main health issue in developing countries, responsible for 50% deaths in children under 5 years of age. Over 50% children in South Asia are malnourished and half of the world malnourished children reside in Pakistan, India and Bangladesh. Malnutrition is of two types; under nutrition and over nutrition. Pakistan is facing both problems but over nutrition is not much prominent (Shela, 2012).

The world health organization (WHO, 2004) reported that in developing countries malnutrition is a major problem. It results in low birth weight, infectious disease as well as other problems. (NEIC, 2004). It is mentioned that in the survey of 2001-2002 children between ages of 6 months and 5 years were underweight and stunted, while 12.5% women's were malnourished. Half of the child deaths worldwide are due to malnutrition (WHO, 2004). Nutritional deficiency leads to diarrheal diseases, acute respiratory infections and other infections that further

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compound the situation with adverse effects on the health of children as well as of mothers (Lodhi et al., 2010).

Malik and Mazhar (2006) mentioned that 26.7% of pre-school children in the developing world were underweight as reflected by a low weight-for-age and 32.5% were estimated to be stunted, based on a low height-for-age. Khan (2004) reported 15% children are wasted 35.5% stunted and 37% facing severe impairment of growth due to malnutrition.

Malnutrition is responsible for 10.7 million deaths among 5- year old children each year in the developing countries. About 30% population is currently suffering multiple forms of malnutrition (Awasthi et al., 2012).

Protein Energy Malnutrition (PEM) is also known as multideficiency state. National Nutrition Foundation (NNF) found that protein malnutrition is identified as a major health problem. It even causes death and sickness and leads to mental and physical retardation as well as respiratory infections, intestinal worms and diarrhea in children. The insufficient supply of quality and quantity of food is responsible for causing anemia which is due to iron deficiency, folate and vitamin B_{12}. (WHO, 2004).

Iron deficiency is most prevalent nutritional problem in the world affecting more than 700 million people in the world (De Maeyer and Adiels, 1985).

Zinc is an essential trace element contained in protein rich foods such as whole grains, meat, fish and shellfish. Zinc deficiency often accompanies protein/calorie malnourishment (Favier et al.,1992). Zinc deficiency syndromes have been reported in adolescents, infants and, more recently, in school-age children. Zinc is an important nutrient for human health and essential to life, plays vital role in the health of hair, bones, nails, muscles, teeth as well as for nerves, brain and growth. It is required for metabolic activities of 300 enzymes (these enzymes are important for synthesis of fat, protein, carbohydrate and alcohol) as well as work for cell division and synthesis of DNA. Zinc is also very important in the proper functioning of thyroid gland (Halsted et al., 1972; Bhowmik et al., 2010).

Biscuits are ready-to-eat, cheap and conveniently eating food among all age groups in many countries of the world (Hussein et al., 2006; Iwegbue, 2012). Therefore, in present study biscuits are selected for supplementation

Keeping in view the malnutrition and low energy intake among the children in Pakistan, the current study is designed to develop high energy composite flour biscuits supplemented with chickpea oat and micronutrient natural sources.

MATERIALS AND METHOD

Raw Materials

Chickpea flour, oat and patent flour were procured from the local market of Islamabad.

Composite flour was prepared by replacing patent flour with chickpea and oat with following different proportions whereas T_1 (100 % patent flour) was kept as control.

T_1 = (Control: from 100% patent flour)

T_2 = (05% chickpea + 05% oat + 90% patent flour)

T_3 = (10% chickpea + 05% oat + 85% patent flour)
T_4 = (10% chickpea + 10% oat + 80% patent flour)
T_5 = (15% chickpea + 10% oat + 75% patent flour)
T_6 = (15% chickpea + 15% oat + 70% patent flour)
T_7 = (20% chickpea + 15% oat + 65% patent flour)
T_8 = (20% chickpea + 20% oat + 60% patent flour)

Preparation of Biscuits

Biscuits were prepared according to method described by American Association of Cereal Chemists (AACC, 2000) Method No.10.52 with slight modifications. Biscuits were prepared by using patent flour chickpea and oat flours with different proportions including sugar, shortening, eggs and baking powder. Mixing was done with mixer of Sanyo food factory instead of that mentioned in AACC (2000) method. Prepared nutritious biscuits were packed for further analysis.

Chemical Analysis

Biscuits were analyzed for different parameters including moisture, ash, protein, fat, crude fiber and minerals (iron and zinc) according to the methods as described by AOAC (2005).

Sensory Evaluation of Biscuits

Sensory evaluation of the biscuits prepared by supplementing different levels of composite flour was done according to 9 point hedonic scale described by Larmond (1997).

Statistical Analysis

The data was analyzed statistically by complete randomized design (CRD) are described in Statistical procedure for agriculture research by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Fresh nutritious biscuits were prepared from different composite flours analyzed for moisture, ash, protein, fat, crude fiber, Fe and Zn. Chemical analysis of nutritious biscuits revealed that supplementation level of composite flour in biscuits significantly affected the moisture content of the biscuits (Table 1). Highest moisture content was observed in T_3 and T_4 and decrease in moisture with increase of supplementation, lower moisture content in T_7 and T_8 which is good from storage point of view. Present findings of moisture content are in accordance with the findings of the Masoodi and Bashir (2012) who also found decrease in the moisture content of biscuits fortified with flaxseeds. Ash content of the nutritious biscuits increased with increase of supplementation level as compared to control. Highest ash content was observed in T_7 and T_8, increase in the ash content of the biscuits is indication of increase in their mineral content. Previously similar findings were reported by Ergin and Herken (2012).

Results regarding protein also showed increase with increase in supplementation level of chickpea and oat. High protein contents were observed in T_7 (20% chickpea + 20% oat + 65% patent flour) and T_8 (20% chickpea + 20% oat + 60% patent flour) which is desirable and the aim

Table 1. Chemical analysis of biscuits made up of composite flour with different levels of chickpea + oat

Biscuits	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	C. fiber (%)	Iron (mg $100g^{-1}$)	Zinc (mg $100g^{-1}$)
$T_{1\ (control)}$	4.76^{ab}	1.06^{f}	6.44^{h}	21.40^{g}	3.77^{h}	2.30^{f}	0.94^{g}
T_2	4.68^{bc}	1.24^{e}	7.30^{g}	21.93^{f}	4.25^{g}	3.03^{e}	1.20^{f}
T_3	4.80^{a}	1.38^{d}	8.08^{f}	22.19^{e}	4.60^{f}	3.15^{d}	1.30^{ef}
T_4	4.83^{a}	1.54^{c}	8.25^{e}	22.51^{e}	4.97^{e}	3.24^{d}	1.46^{de}
T_5	4.60^{cd}	1.60^{c}	8.96^{d}	22.70^{d}	5.27^{d}	3.34^{c}	1.57^{cd}
T_6	4.53^{de}	1.79^{b}	9.10^{c}	23.03^{c}	5.64^{c}	3.43^{c}	1.72^{bc}
T_7	4.52^{de}	1.80^{ab}	9.84^{b}	23.23^{a}	5.96^{b}	3.57^{b}	1.81^{ab}
T_8	4.48^{e}	1.90^{a}	9.99^{a}	23.56^{a}	6.34^{a}	3.68^{a}	2.00^{a}

Means followed by same letters do not differ significantly at P <0.05.

of our study. Increasing trends of protein was also noted by Niaba et al. 2013, who found increase in protein content of biscuits with increasing level of soy flour in the formulation of biscuits. The mean values for crude fat contents of nutritious biscuits were found highest in treatment T_7 (20 % chickpea + 15% oat+90% patent flour) and treatment T_8 (20 % chickpea + 20% oat + 90% patent flour). Similar trends were noted by Ogunjobi and Ogunwolu (2010). They observed decrease in the fat content of cassava flour biscuits supplemented with cashew apple flour. ANOVA showed that crude fiber content of the biscuits significantly increased ($P<0.05$) with increase of supplementation level as well as change of composition, while the control sample (100 %) had least value of fiber which is due to low fiber content in patent flour (white flour). Highest fiber content were recorded in T_7 (20 % chickpea+15 % oat+65 % patent flour) and T_8 (20 % chickpea+ 20 % oat+60 % patent flour). Similar observations were experienced by Ogunjobi and Ogunwolu (2010), who found increase in the fiber content of cassava flour biscuits supplemented with cashew apple flour. Increase in the fiber content of the biscuits is desirable because fiber is good to control cholesterol level and many digestive problems as well as colon cancer. Increase in iron and zinc was found with increase in the level of supplementation of chickpea and oat in biscuits. The increase in the iron and zinc content was significant. Highest increase of zinc and iron contents were observed in T_7 (20 % chickpea + 15 % oat + 65 % patent flour) and T_8 (20 % chickpea + 20 % oat + 60 % patent flour). The same increase in iron and zinc was also observed by Abou-Arab et al. (2010).

Sensory Evaluation

Fresh nutritious biscuits prepared from different composition were subjected to sensory evaluation for texture, color, taste, aroma and flavor and overall acceptability. Evaluation was done by a panel of judges (Larmond, 1997) with instruction score card.

Evaluation was done thrice and

Table 2. Sensory Evaluation

Biscuits	Texture	Color	Taste	Aroma	Flavor	Acceptance
$T_{1\ (control)}$	6.4 ^{ab}	6.8 ^{ab}	6.5 ^{ab}	5.4 ^{ab}	7.0 ^{a}	6.8 ^{ab}
T_2	6.4 ^{ab}	6.8 ^{ab}	6.2 ^{c}	5.2 ^{ab}	6.4 ^{ab}	6.0 ^{b}
T_3	5.8 ^{ab}	5.6 ^{c}	6.4 ^{ab}	5.4 ^{ab}	6.0 ^{ab}	6.4 ^{ab}
T_4	5.8 ^{ab}	5.8 ^{bc}	6.0 ^{c}	4.6 ^{b}	5.0 ^{b}	6.0 ^{b}
T_5	6.0 ^{ab}	6.2 ^{abc}	6.0 ^{c}	5.0 ^{ab}	5.8 ^{ab}	6.3 ^{ab}
T_6	5.6 ^{b}	6.4 ^{abc}	6.6 ^{ab}	5.4 ^{ab}	6.4 ^{ab}	7.1 ^{a}
T_7	6.9 ^{a}	7.2 ^{a}	7.0 ^{a}	6.7 ^{a}	7.4 ^{a}	7.2 ^{a}
T_8	5.4 ^{b}	6.0 ^{bc}	5.8 ^{d}	5.6 ^{ab}	6.2 ^{ab}	6.0 ^{b}

Means followed by same letters do not differt significantly at P <0.05.

means scores were calculated (Table 2).Sensory evaluation of nutritious biscuits for different parameters shows significant differences among different treatment.

Texture

The results indicated that there is significant difference among all treatments of nutritious biscuits. Control sample got 6.4 score and T_7 got the highest score (6.9).The difference in texture is due to high protein content in chickpea and oat. Similar findings were obtained by Conforti et al. (2007).

Color

There is significant change in the color of the biscuits prepared from composite flour among different treatments. The color score range between 5.6 and 7.2. Change in color may be due to high protein content in the raw material. Findings of Siddiqui et al. (2003) are in conformity with present results.

Taste

Biscuits hold an important position in snack food due to variety in tastes, crispness and digestibility. Sensory evaluation for taste of the biscuit changed with the change in composition. Highest score were noted by T_7 and control (100 % patent flour). Lowest score was obtained in T_8. Our findings are in accordance with the findings of Dhingra et al. (2000).

Aroma

Data regarding aroma showed that T_4 and T_5 got the lowest score (10% chickpea 10% oat 80% patent flour) T_5 (10% chickpea + 10% oat + 80% patent flour). Highest scores were obtained by two treatments, control and T_7. Decreasing trend in the score of the aroma of the nutritious biscuits was due to increasing content of protein in chickpea and oat. Similar trends were obtained by Siddiqui et al. (2003).

Flavor

All the treatments were in acceptable range for flavour. Control treatment and treatment T_7 (20% chickpea 15% oat and 65 % patent flour) got the highest score. Same trends of flavor were witnessed by Emmanue et al. (2012). They observed the change of flavor with

change of supplementations level.

Overall Acceptability

Data regarding over all acceptability vary significantly among different treatments. Treatment T_7 (20 % chickpea + 15%oat and 65 % patent flour) and T_6 (15 % chickpea + 15 %oat + 70 % patent flour) scored highest while T_2 (5% chickpea + 5 % oat + 90 % patent flour) got lowest score. Overall acceptability is totally different in quality parameters and it was not affected by individual trend of color texture and flavor. Siddiqui et al. (2003), Chakrabarti et al. (2001) also obtained results in confirmity with the present study.

The nutritional value of all treatments improved gradually with increasing levels of supplementation with chickpea and oat, but sensory acceptance of product is of main importance. the success of product in the market is decided by organoleptic sensory evaluation. Therefore in the present study treatment T_7 (20% chickpea + 15% oat + 65% patent flour) is recommended for production.

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