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Development and quality evaluation of multigrain cookies

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Abstract

Baking Industry is considered as one of the major segments of food processing in India. Bakery products have become popular among different cross sections of the population due to an increased demand for convenience foods. Cookies, among the bakery products, are most significant in the world. These are an important food product used as snacks by children and adults. Cookies differ from other baked products like bread and cakes due to their low moisture content which ensures that they are free from microbial spoilage and confer a long shelf life on the product. The present investigation is an attempt to formulate higher nutritional value of cookies with added health benefit by addition of green gram flour and oats flour with whole wheat flour. In the present study treatment T0, T1, T2 and T3 were formulated in which multigrain cookies was prepared by using Whole Wheat Flour: Oats Flour: Green Gram Flour (WWF: OF: GGF) was in the ratio of (100:00:00, 70:20:10, 70:15:15, 70:10:20) respectively. It was found that among all treatments T3 scored higher in body and texture (7.9), flavour and taste (7.8), overall acceptability (7.40) was considered as optimized product. The carbohydrate, protein, fat, ash, Total Solid (TS) and moisture percent of T3 treatment was found to be 40.97, 18.45, 28.17, 1.89, 89.55 and 10.35 respectively.

Keywords: Cookies, wheat flour, green gram flour, oats

1. Introduction

Baking industry is currently seeking to expand its products range, but also to constitute a way of maintain and improving people's health. Baking Industry is considered as one of the major segments of food processing in India. In recent years in India, bakery products have become popular among different cross sections of the population due to an increased demand for convenience foods. Bread and cookies accounting for 80% of total bakery products produced in the country (Davidson, 2016) [12]. Bakery products are mainly prepared from wheat as a main ingredient. Baked products are gaining popularity because of their availability, ready-to-eat convenience and reasonably good shelf life. Cookies are ideal for nutrient availability, palatability, compactness and convenience (Chappalwar, 2013) [10]. Cookies are widely consumed and are an ideal vehicle for functional delivery. The bulk of Indian people diet is vegetarian and the major part of energy and protein comes from cereals and pulses. The role of cereals and pulses is so important in our diets that a series of products had evolved in the Indian culinary based on the combination of cereals and pulses. These cereal-pulse based foods have gained a prominent place in our everyday diets. Elderly are becoming a large proportion of the world's population in developed and developing countries, increasing from 0.6 billion in 2000 to 2 billion by 2050 (World Health Organization, 2002) [29]. The health care costs for this growing age group will likewise increase, especially for curative care, even though prevention is recognized as more economical and sustainable (Chernoff, 2006) [9]. The cookie is old, the name is new. Food historians place the first recipe named "Mexican wedding cakes" in 1950s (Herbst, 2001) [14]. Cookies, among the bakery products, are most significant in the world. These are an important food product used as snacks by children and adults (Hussain *et al.*, 2000). Cookies differ from other baked products like bread and cakes because of their low moisture content which ensures that they are free from microbial spoilage and confer a long shelf life on the product (Wade, 1988) [28]. Cookie is a small, flat, sweet, baked food, usually containing flour, eggs, chocolate, sugar and either butter or cooking vegetable oil. It may also include other ingredients such as raisins, oats, dry fruits or nuts. They come in an infinite variety of sizes, shapes, composition, texture, tenderness, colour and taste (Pyler, 1988) [20].

1.1 Grains

Grain is a small, hard, dry seed, with or without an attached hull or fruit layer and harvested for human or animal consumption (Babcock, 1976) ^[8]. A grain crop is a mainly grain-producing plant. The two main types of commercial grain crops are cereals and legumes. After being harvested, dry grains are more durable than other staple food like starchy fruits and tubers. This durability has made grains well suited to agriculture industry, since they can be mechanically harvested, transported by rail or ship, stored for long periods in silos, and milled for flour or pressed for oil. Thus, major global commodity markets exist for canola, maize, rice, soybeans, wheat, and other grains but not for tubers, vegetables, or other crops. Cereal grains contain a substantial amount of starch (Serna-Saldivar, 2012) ^[23], a carbohydrate that provides dietary energy. Legumes/pulses are considered to be an important group of plant food stuffs, particularly as a cheap source of protein when animal protein is scarce. A significant part of human population relies on legumes as staple food, particularly in combination with cereals. In addition to proteins, legumes supply adequate concentration of minerals, vitamins and carbohydrate (Siddhuraju *et al.* 2002) ^[25]. Cereals and other crops also supply a substantial level of protein and high levels of carbohydrates. However, in some of these foodstuffs, the utilization of available protein and carbohydrates is much less than that calculated from the chemical composition because of the presence of various antinutritional or anti physiological substances (Makkar *et al.* 1998; Siddhuraju *et al.*, 2000) ^[17, 24]. Oilseed grains are grown primarily for the extraction of their edible oil. Oilseed grains are grown primarily for the extraction of their edible oil. Vegetable oils provide dietary energy and some essential fatty acids (Lean, 2006) ^[16]. Vegetable oil are also used as fuel and lubricants (Salunkhe, 1992) ^[22].

1.2 Wheat

Wheat is the most common cereal available all over the world and is in even higher demand in recent years due to its abundant health benefits. Wheat is an immense energy source through all parts of the grain kernel, including the bran, germ, and endosperm. Wheat is the principal cereal widely used for making bread than any other cereal. The protein called gluten makes bread dough stick together and gives it the ability to retain gas (Narayana *et al.*, 1982) ^[18]. Wheat supplies about 20 percent of the food calories for the world's people and is a national staple in many countries. Wheat is the major ingredient in most breads, rolls, crackers, cookies, biscuits, cakes, doughnuts, macaroni, spaghetti, puddings, pizza, and many prepared hot and cold breakfast foods. Wheat is rich in catalytic elements, mineral salts, calcium, magnesium, potassium, sulfur, chlorine, arsenic, silicon, manganese, zinc, iodide, copper, vitamin B, and vitamin E. Wheat is the major contributor of protein content of daily diet (Wahab Said *et al.*, 2014) ^[30]. This wealth of nutrients is why it is often used as a cultural base or foundation of nourishment. Issues like anemia, mineral deficiencies, gallstones, breast cancer, chronic inflammation, obesity, asthenia, tuberculosis, pregnancy and breastfeeding problems are quickly improved by consuming whole wheat. Much of the wheat used for livestock and poultry feed is a by-product of the flour milling industry (Oh *et al.*, 1985) ^[19]. The nutrients in it are retained even after processing it into flour. Wheat flour is a powder made from the grinding of wheat used for human consumption. More wheat flour is produced than any other flour. Wheat varieties are called soft if gluten content is low and are called hard if they have high

gluten content. Hard flour, or bread flour, is high in gluten, with 12% to 14% gluten content, and its dough has elastic toughness that holds its shape well once baked. Soft flour is comparatively low in gluten and thus results in a loaf with a finer, crumbly texture. As human population continued to grow, there is a considerable worldwide interest in the utilization of wheat based food products. Comparative analysis of several food products from wheat flour for both human and animal feed is of greater concern (Anonymous, 2008) ^[1].

1.3 Legumes

Legumes are major source of dietary protein for large sector of the world's population. The composition is predominant in countries where utilization of animal protein is limited owing to poverty, non-availability, religious or cultural lifestyles (Boye *et al.*, 2001) ^[4]. Legumes are high in protein and complex hydrocarbons. Along with presence of appreciable quantity of bioactive ingredients and minerals (Bazzano *et al.*, 2010; Rizkalla *et al.*, 2002; Bazzano *et al.*, 2008) ^[5, 6]. Some legume seeds are important sources of dietary proteins particularly in countries where animal proteins are scarce (Venkatsan, 1968) ^[27]. Legume pulses appear prominent in meeting such an objective, their prospect is not without reservations. Their beany flavour, digestion inhibitors and their starch contents are some of the important problems related to their use.

1.4 Oats

Oats (*Avena Sativa* L.) are good source of proteins, fiber and minerals. The amount of oats used for human consumption has increased progressively, the fact health effects of oats benefits mainly on the total dietary fiber and B- glucan content (Ahmad *et al.*, 2014) ^[2]. The bran and germ of oats also contain phytochemicals including tocopherols, tocotrienols, phenolic compounds and plant sterols, thought to have a beneficial effect on health (Wahab Said *et al.*, 2014) ^[30]. Generally, oats have been qualified as feed grain of little value. In Polish tradition flaked oat grains are consumed as a component of curative diets and found rather in the menu of poor families (Bartnik & Rothkaehl, 1997) ^[7]. Oats are rich source of dietary fiber but more importantly, oats are high in fiber, specifically, b-glucan, which reduces blood cholesterol level by increasing the excretion of bile in the body (Jenkins and Kendall, 2002) ^[15]. Oats can be considered a high calorie food containing 19 per cent more calories than wheat. Oats are also rich in the B vitamins, contain the anti-oxidant vitamin E and oats are mineral rich as well. Oatmeal is a tonic for general debility, treats anorexia, is good for convalescence and fatigue, lowers blood cholesterol levels and helps to control hormonal activity. Oatmeal cuts the risk of strokes and heart attacks from blocked arteries, stabilizes blood sugar and increases the body's ability to fight off infectious disease (Anwar, 2013) ^[13]. Oats contain little gluten, they were considered not good for much more than animal feed.

1.5 Green Gram

Green gram is a protein rich staple food. It contains 25 per cent protein, which is almost three times that of cereals. It supplies protein requirement of vegetarian population of the country. The biological value improves greatly, when wheat or rice is combined with green gram because of the complementary relationship of the essential amino acids. Green gram is a very nutritious food rich in high grade vitamin B1 and B2, minerals mainly iron and proteins. The country's population, which is currently more than 1.16 billion, is expected to reach 1.26

billion by March 2016. According to 2001 census, 35 per cent of the population is in the childhood age (0-14 years) (Chaudhary, 2007). The countrywide National Family Health Survey (NFHS) showed that more than 50 per cent of the children are undernourished. UNICEF has also reported that India has the largest number of malnourished children. Earlier the main cause of malnutrition among children was considered to be due to protein deficiency (Srilakshmi, 2003) [26].

2. Materials and Methods

The research "Development and quality evaluation of Multigrain Cookies prepared using Green gram flour, Oats and Whole wheat flour" was conducted at the research lab of "Cyto Gene Research & Development" B – Block Chauraha, Indra Nagar, Lucknow, India – 226016.

2.1 Raw Material

All the ingredients such as green gram flour, oats flour, whole wheat flour, butter or oil, baking powder/baking soda and skim milk were collected from the local market Bhoothnath Indra Nagar, Lucknow. All the chemicals used in the present study AR grade and LR grade.

2.2 Treatment combination

T0 -Control prepared from whole wheat flour (WWF) (100%)
 T1 –Experimental sample prepared from whole wheat flour (WWF), oat flour (OF) and green gram flour (GGF) (70:20:10)
 T2 –Experimental sample prepared from whole wheat flour (WWF), oats flour (OF) and green gram flour (GGF) (70:15:15)
 T3 –Experimental sample prepared from whole wheat flour (WF), oats flour (OF) and green gram flour (GGF)(70:10:20)

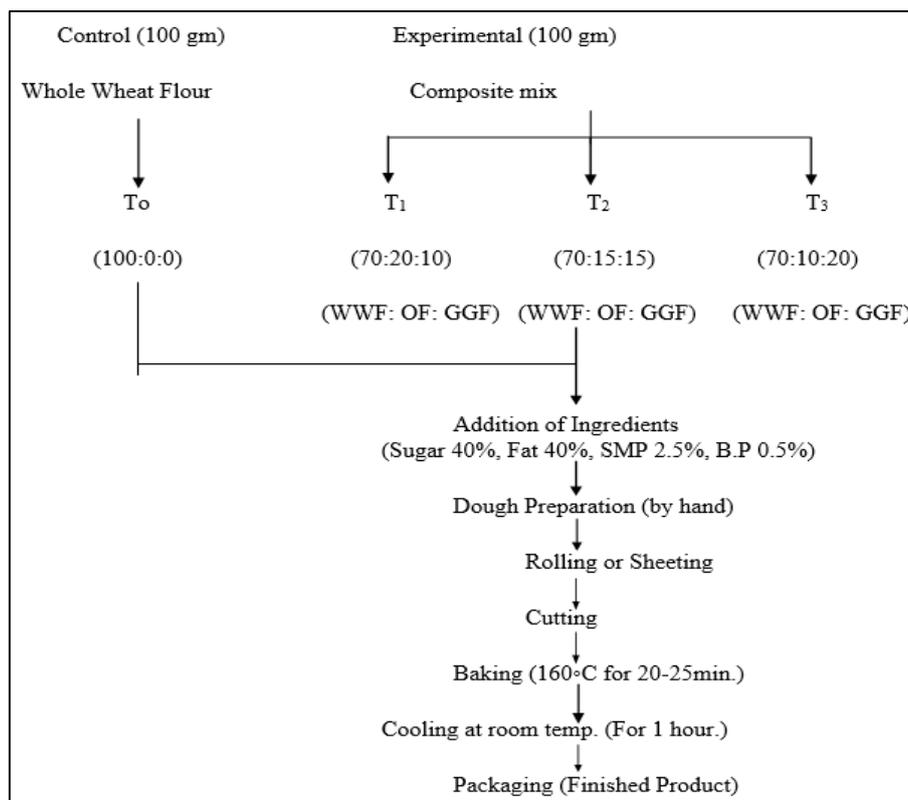


Fig 1: Flow diagram for preparation of cookies

2.3 Sensory analysis

Multigrain cookies prepared by using green gram flour, oats flour and whole wheat flour was served to panel members consisting of 6 experienced persons using 9-point hedonic scale (Amerine *et al.*, 1965)

2.4 Physico-chemical analysis

The multigrain cookies samples of different treatments were analyzed for their different analytical methods. Fat was determined by AOAC 934.01. Protein percent was estimated by Kjeldahl method. Carbohydrate percent was estimated by difference method. Ash percent was estimated by AOAC 900.02A. Moisture was determined as per the procedure given in AOAC 2000.

2.5 Microbiological analysis

The microbiological analysis i.e. standard plate count, coliform and yeast and mould test of the multigrain cookies samples of different treatments was done by using standard procedure laid down in I.S. 1947 PART III.

2.6 Statistical analysis

Data was analysed using Analysis of Variance (ANOVA) and Critical difference (C.D) in WASP software and excel software. The significance were separated at ($p < 0.05$).

3. Results and Discussion

The data collected on the different aspects were tabulated and analyzed statistically using the method of analysis of variance and critical difference technique. The significant and non-significant differences observed have been analyzed critically within and between the different treatment combinations. The analyzed data is presented in this chapter under the following headings:

1. Chemical characteristics
2. Organoleptic characteristics
3. Microbial characteristics

Table 1: Average data for different parameters of control and experiments (in percent)

Parameters	Treatment			
	T0	T1	T2	T3
1. Physico-chemical analysis				
Carbohydrate%	47.85	42.82	41.77	40.97
Protein%	14.71	17.58	18.06	18.45
Fat%	27.62	29.15	28.67	28.17
Ash%	1.63	1.72	1.81	1.89
Total Solids%	91.82	91.37	90.24	89.55
Moisture%	8.17	8.62	9.75	10.35
2. Organoleptic Score (9-Point hedonic scale)				
Colour & Appearance	7.6	7.5	7.2	6.52
Body & Texture	7	7.4	7.1	7.9
Flavour & Taste	7	7.1	7.4	7.8
Overall acceptability	7.13	7.29	7.23	7.40
3. Microbial analysis				
SPC cfu/g	14.8	14	12.2	11.6
Yeast & Mould	6.4	5.4	5.4	4.4
Coliform	NIL	NIL	NIL	NIL

3.1 Effect of addition of green gram flour, oats and whole wheat flour on organoleptic score of multigrain cookies samples

The multigrain cookies samples were subjected to organoleptic evaluation before a panel of trained judges by using a 9 point hedonic scale. The samples were evaluated for colour& appearance, body & texture, flavor and taste and overall acceptability. The mean value of colour and appearance content in T0, T1, T2 and T3 were noted as 7.6, 7.4, 7.2 and 6.52 respectively. the data shown that colour and appearance

content in samples of different treatments and control, the highest mean value of colour and appearance was recorded in the sample of T0 (7.6) and lowest mean value of colour and appearance was recorded in the sample of T3 (6.52). Similarly, the mean value of flavour and taste content in T0, T1, T2 and T3 were noted as 7.0, 7.1, 7.4 and 7.8 respectively. The data shown that flavour and taste content in samples of different treatments and control, the highest mean value of flavour and taste was recorded in the sample of T3 (7.8) and lowest mean value of colour and appearance was recorded in the sample of T0 (7.0). Similarly, the mean value of body and texture content in T0, T1, T2 and T3 were noted as 7.0, 7.4, 7.1 and 7.9 respectively. the data shown that body and texture content in samples of different treatments and control, the highest mean value of body and texture was recorded in the sample of T3 (7.9) and lowest mean value of body and texture was recorded in the sample of T0 (7.0). Likewise, the mean value of overall acceptability content in T0, T1, T2 and T3 were noted as 7.13, 7.28, 7.22 and 7.39 respectively. the data shown that overall acceptability content in samples of different treatments and control, the highest mean value of overall acceptability was recorded in the sample of T3 (7.39) and lowest mean value of overall acceptability was recorded in the sample of T0 (7.13). The organoleptic scores are presented graphically in Fig 2. From the figure, it can be observed that treatment T3 scored was significantly higher values for body & texture, flavour and taste and overall acceptability as compared to other treatments including control. Therefore, multigrain cookies samples of T3 treatment was taken as the optimized product.

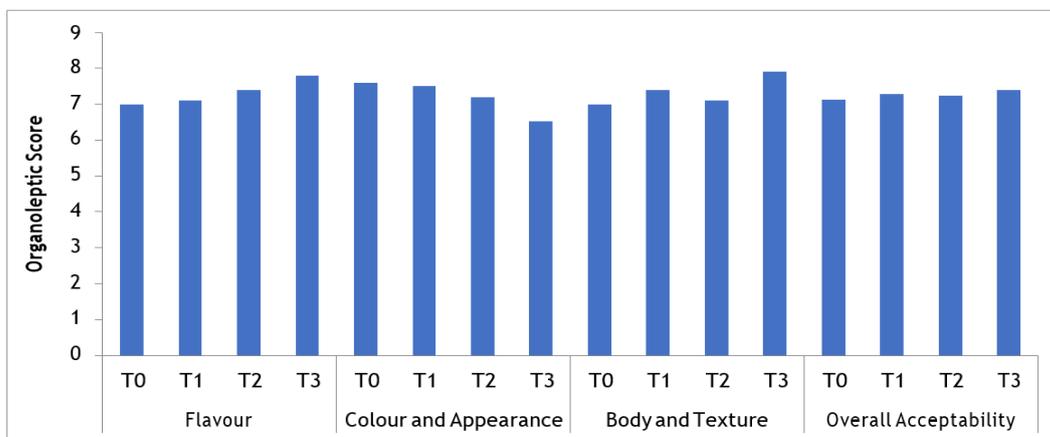


Fig 2: Average values for flavour, colour and appearance, body & texture and overall acceptability of multigrain cookies

3.2 Effect of addition of green gram flour, oats and whole wheat flour on physico-chemical, microbiological quality of multigrain cookies samples.

The carbohydrate percentage for multigrain cookies samples of T0, T1, T2 and T3 treatments was found to be 47.85%, 42.82%, 41.77% and 40.97% respectively. The carbohydrate of different treatment decreased significantly ($P < 0.05$). The protein percentage of multigrain cookies samples of different treatments of T0, T1, T2 and T3 was found to be 14.71%, 17.58%, 18.06% and 18.6% respectively. There was significant difference among the treatments ($P < 0.05$). The fat percentage of multigrain cookies samples of different treatments of T0, T1, T2 and T3 was found to be 27.62%, 29.15%, 28.67% and 28.17% respectively. There was significant difference among the treatments ($P < 0.05$). The ash percentage for multigrain cookies samples of T0, T1, T2 and T3 treatments was found to

be 1.63%, 1.72%, 1.81% and 1.89% respectively. There was significant difference among the treatments ($P < 0.05$). The total solid of T0, T1, T2 and T3 was found to be 91.82%, 91.37%, 90.24% and 89.55% respectively. The total solid percentage of different treatments decreased significantly ($P < 0.05$). The moisture percent of T0, T1, T2 and T3 was found to be 8.17%, 8.62%, 9.75% and 10.35% respectively. The moisture percentage of different treatments increased significantly ($P < 0.05$). Standard plate count of multigrain cookies samples of different treatments viz., T0, T1, T2 and T3 was found to be 14.8cfu/g, 14cfu/g, 12.2cfu/g and 11.6cfu/g respectively. There was significant difference among the SPC. Yeast and mould count of multigrain cookies samples of different treatments viz., T0, T1, T2 and T3 was found to be 6.4 cfu/g, 5.4 cfu/g, 5.4 cfu/g and 4.4 cfu/g respectively. There was significant difference among the treatments. The coliform counts of different samples were found to be absent.

4. Summary and Conclusion

The carbohydrate percentage in samples of different experimental treatments and control, the highest mean value of carbohydrate percentage was recorded in the sample of T0 (47.85) and lowest was T3 (40.97). Similarly, the Protein percentage in samples of different experimental treatments and control, the highest mean value of protein percentage was recorded in the sample of T3 (18.45) and lowest was T0 (14.71). Similarly, the fat percentage in samples of different experimental treatments and control, the highest mean value of fat percentage was recorded in the sample of T1 (29.15) and lowest was T0 (27.62). The ash percentage in samples of different experimental treatments and control, the highest mean value of ash percentage was recorded in the sample of T3 (1.89) and lowest was T0 (1.63). The total solid percentage in samples of different experimental treatments and control, the highest mean value of total solid percentage was recorded in the sample of T0 (91.82) and lowest was T3 (89.55) and moisture percentage in samples of different experimental treatments and control, the highest mean value of moisture percentage was recorded in the sample of T3 (10.35) lowest was and T0 (8.17). The differences in these values of carbohydrate, protein, ash, fat, Total Solid (TS) and moisture percent of all treatment were significant.

The standard plate count score in samples of different treatments and control, the highest mean value of standard plate count score was recorded in the sample of T0 (14.8) and lowest was T3 (11.6). The differences in these values of SPC scores all treatment were significant. Similarly, Yeast and mould score in samples of different treatments and control, the highest mean value of Yeast and mould score was recorded in T0 (6.4) and lowest was T3 (4.4). The differences in these values of Yeast and mould scores all treatment were significant. Similarly, the coil form count in control and experimental sample of multigrain cookies were found to be absent.

In view of the experimental result obtained during the present investigation, it may be concluded that multigrain Cookies can be successfully prepared by using Green Gram flour and Oats flour with Whole Wheat flour. Cookies made with Green Gram and Oats in treatment T3 was best in terms of organoleptic characteristics and received highest score (body & texture, flavour & taste, overall acceptability).

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