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Process optimization and quality evaluation of fasting cookies developed by incorporating water chestnut, sweet potato, Amaranth Grain Flour

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Abstract
Nowadays people are health conscious, they like value added product as a part of their everyday meal or as well as the foods they eat for pleasure. The composite flour was based on fasting ingredients. In this experiment, water chestnut (50, 60 & 70), sweet potato (35, 25 & 15) and amaranth (15, 15 &15) flour in the various proportions to prepare three blended flour samples, from which fasting cookiess were prepared. These samples were subjected to analysis of their functional properties. The proximate composition of the various flour blends used for the preparation of fasting cookiess were determined using standard methods. The physico-chemical analysis and sensory evaluation was done to know the acceptability of fasting cookies. These were evaluated for sensory analysis that included colour, taste, flavour, texture and overall acceptability. The cookiess were analyzed for analytical and chemical analysis, which includes moisture content, fat content, total ash content, protein content, minerals content and carbohydrate content. On the basis of sensory evaluation, cookies containing water chestnut, sweet potato, amaranth flour in (70, 15&15) proportion scored high score for overall acceptability i.e. 7. From the result of proximate analysis of cookiess, the fat content of Sample C is very low i.e. 24.18%, which is beneficial for health. So according to quality evaluation and sensory evaluation, preparation of cookiess from water chestnut, sweet potato and amaranth flour blend in proportion of (70, 15 & 15) is recommended.

Keywords: fasting cookies, water chestnut, sweet potato and amaranth grain

Introduction
The **b**akery industry in India is more populated is all the branches of the biggest in food industry. Bakery is a long-established activity and occupies an important place in food processing industry. Bakery products are like breads, cookies, muffin and cakes are consumed by 96% of the population in the United Kingdom (Foster *et al.,* 2006) [9]. Bakery product have become in India since the earlier times. Among the different bakery product, cookies constitute the most popular group. Cookies were first invented s a food for Nelson' Navy (1980). Cookies are chemically leavened bakery products containing high percentage of fat and sugar. India is known to be a second largest manufacturer of cookies, products the first being USA. Cookies cover 70% of the total production of bakery industry. Indian Cookies industry came into limelight and started gaining a sound status in the bakery industry in the later part of the 20th century when the urbanized society call for readymade food products at a tenable cost. Fasting is also seen as way to give the body a much needed break from the regular dietary routine. The explains the choice of food items that are light on stomach, easy to digestion but are full of nutrients. So making fasting cookies means ready to eat food without any physical work you can consume with full energy dense without any extra fat which dangerous to our body. Therefore few food items like water chestnut, sweet potato, and amaranth go into making a variety of flour, which could easily fill in the space created by the absence of refined flour or wheat flour cookies. Because of water chestnut is gluten free at the same is extremely nutritious. Water chestnut is rich in carbohydrate, fibre, vitamins and minerals. Another ingredients that attains great important Navratris amaranth and sweet potato which also full of nutritional qualities making this composite flour cookies gives best output energy to your body during Fasting days while you busy work schedule, lack of time preparing Fasting food then those days can make this type of cookies and storage for at least one month in between you can consume it regularly.

Water chestnut (WC) (*Trapa natans*) commonly known as 'Singhara' in India. It is an annual, floating leaved aquatic plant found in freshwater wetlands, lakes, ponds, and sluggish reaches of rivers in India (Rodrigues *et al.,* 1964) [14], particularly in Madhya Pradesh, Uttar Pradesh, Bihar and Orissa where high rainfall is conducive to successful cultivation (Little. 1979) [11]. The genus Trapa being composed of about 30 species. Trapa natans var. natans, are now widely spread in Eurasia, Africa, Asia and in North Eastern United States, which bears as a four-horned fruit, the latter also known as the Jesuit nut or water caltrops (Karg *et al.,* 2006) [10], whereas Water chestnut (Trapa natans) is one of the most important minor fruit crops grown India. The kernel is delicious which contains carbohydrates, proteins and essential minerals (Singh *et al*., 2010). WC possess different medicinal activities such as anti microbial (Parekh and Chanda, 2007) [12] analgesic (Agrahari *et al.,* 2010) [2] anti-inflammatory (Patel *et al.,* 2010) and anti-diabetic (Das *et al.,* 2011) [6]. Chandana *et al., (*2013) [13] reported When the fruit has been dried, it is ground to flour called "singhara ka atta" which is used in many religious rituals and can be consumed as a Phalahar diet on the Hindu fasting days, in Indian traditional festival "Navratra".

Demirkesen (2010) [7] in order to utilize the nutritional health and also functional advantage of chestnut flour in gluten-free products, there is a growing trend of the use of chestnut flour. (Alfasne *et al.*, 2011) studied the biochemical composition of fruit of water chestnut was studied and concluded that water chestnut could be important sources of carbohydrate, protein, minerals, which is suitable for incorporation in human diet.

Amaranth species grown in the Czech Republic (Amaranth's cruentus, A. hypochondriacus and A. caudatus) are used for human nutrition in the form of whole-meal amaranth flour, crackers, pasta without eggs, brown bread without gluten, cookies, cookies, etc. Grain amaranth has several attractive features like gluten-free ingredient, high-quality protein, and the presence of abundant quantities of fiber and minerals such as calcium and iron (Ballabio *et al.*, 2011; Moreno, Comino, & Sousa, 2014) [5]. These grains are also a source of many bioactive compounds with health-promoting effects such as phytosterols, polyphenols, saponins, and squalene (Alvarez-Jubete, Arendt, & Gallagher, 2010) [3]. Mlakar, Turinek, Jakop, Bavec & Bavec (2010) Amaranth grains are rich in lysine and tryptophan. To increase its nutritive value, cookies are prepared with fortified or composite flour.

Sweet potato (Ipomoea batatas L. Lam.), more commonly known as kumara, has been cultivated for domestic consumption in many countries throughout the Asia Pacific regions and beyond (Anon, 2000) [4]. Ferris *et al.*, (2001) suggested that however currently dried chips and flour made from sweet potato are limited in use for household consumption and for sale by small business on local markets in Uganda and other sub-Saharan African countries. No industrial scale production of sweet potato flour or starch has been reported in Africa, where as this does occur for other starch staple crops, such as cassava.

Table 1: Nutritional composition of Amaranth grain, Sweet potato, and Water chestnut Flour

Nutritional value Dry	Amaranth grain	Sweet potato	Water chestnut
Moisture (g)	11.1	10.06	13.8
Protein (g)	12.5	5.87	13.4
Fat (g)	6.3	1.48	0.8
Crude fibre (g)	3.6	1.92	_
Carbohydrate (g)	62.17	76.87	68.9
Energy (Kcal)	355.38	344.28	330
Calcium (mg)	159	52.43	70
Phosphorus (mg)	557	47.51	440
Iron (mg)	7.6	23.56	2.4

Source: USDA

Materials and Methods

Procurement of row materials

All most care should be taken in choosing the raw materials for the preparation of the Cookies quality was the major factor in choosing raw material purchased from the local market in Prayagraj.

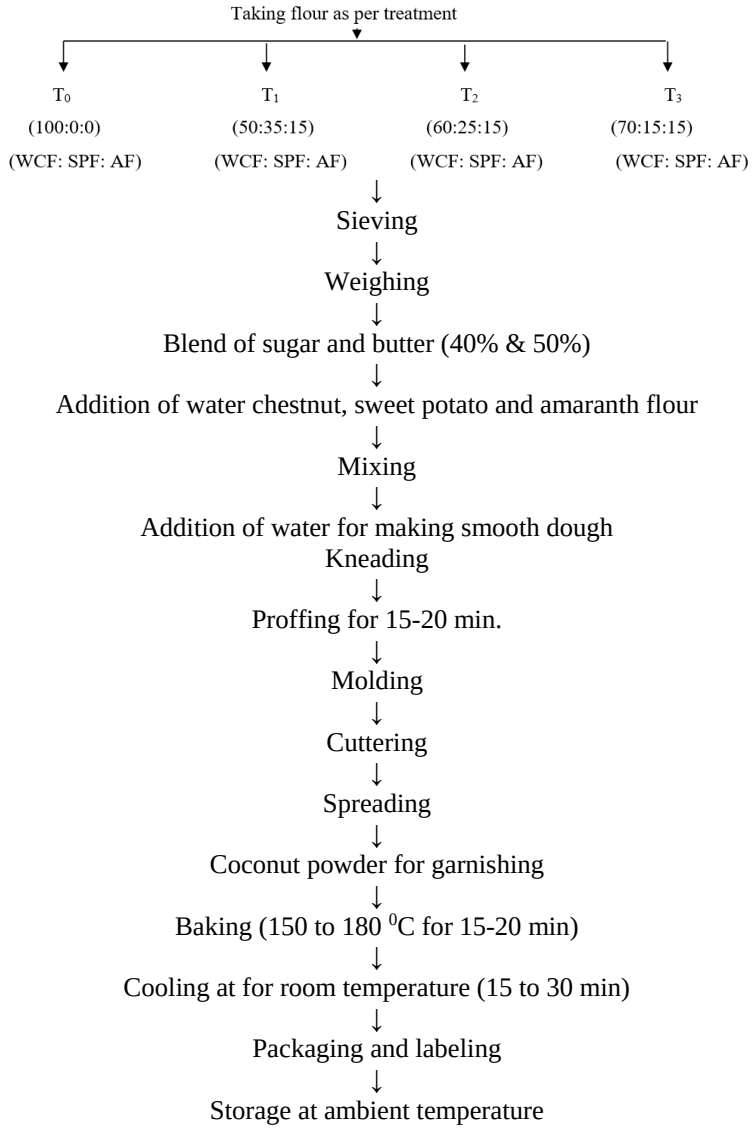
Preparation of Cookies: Cookies were prepared by the standard method for the preparation of. Water chestnut flour, Amaranth flour and Sweet potato flour percentages were 50, 60, and 70% as given Table 1

Table 2

S. No	Water chestnut flour	Sweet potato flour	Amaranth flour
T_0	100	00	00
T_1	50	35	15
T_2	60	25	15
T_3	70	15	15

1. **Chemical Analysis**
   Carbohydrate: This was estimated by {100-moisture +ash+ fat+ protein) %}
   Protein – This was estimated by kjeldhal apparatus by AOAC 1999 method
   Fat: This was estimated by soxhlet apparatus by AOAC 1999 method.
   Ash: This was estimated by muffle furnace as per the procedure given Ranganna 2007.
   TS: This was estimated by {Carbohydrate +ash+ fat+ protein) %}
   Moisture: this was estimated as per the procedure given AOAC, 1999 methood.
2. **Minerals analysiss**
   Iron (mg) Iron content in the Fasting Cookies was determined by AAS (Atomic Absorption Spectrophotometer).
   Calcium (mg) Calcium in the Fasting Cookies was assessed using standardized procedure of AOAC (2005)
3. **Microbial analysis**
   Standard plant count: This was demined as per the procedure given in APHA standard method for the examination of dairy products 1992.
   Yeast and mould count: This was demined as per the procedure given in APHA standard method for the examination of dairy products 1992.
   Coli form t count: This was demined as per the procedure given in APHA standard method for the examination of dairy products 1992.
4. **Sensory Attributes (9 point Hedonic Scale)**
   Colour and appearance, Flavour and taste, Body and Texture, Overall acceptability.

5. Texture Analysis
Hardness of Fasting Cookies
Flow diagram for prepration of cookies



Results and Discussion

It can be observed from the table 1 and fig. 1,2,3,4,5,6 that average of physicochemical analysis in fasting cookies. The average of carbohydrates in fasting cookies T_0 (53.76), T_1 (57.33), T_2 (56.46) and T_3 (53.84). The highest average value of carbohydrates (57.82) was obtained in the treatment T_0. The average of protein content in fasting cookies T_0 (8.72), T_1 (11.58), T_2 (12.07) and T_3 (14.61). The highest average value of protein content (14.61) was obtained in the treatment T_3. The average of Fat content in fasting cookies T_0 (28.62), T_1 (25.14), T_2 (24.67) and T_3 (24.18). The highest average value of Fat content (25.14) was obtained in the treatment T_1. The average of ash content in fasting cookies T_0 (2.38), T_1 (2.42), T_2 (3.38) and T_3 (4.22). The highest average value of ash content (45.18) was obtained in the treatment T_3. The average of total solid in fasting cookies T_0 (94.96), T_1 (93.34), T_2 (93.16) and T_3 (93.75). The highest average value of TS (94.96) was obtained in the treatment T_0. The average of moisture content in fasting cookies T_0 (2.52), T_1 (3.43), T_2 (3.32) and T_3 (3.12). The highest average value of protein content (3.42) was obtained in the treatment T_2.

Table 3: Physicochemical analysis of Fasting cookies

Parameter	Score /value based on mean value of different parameter of treatment				C.D. value at 0.5%
Treatments	T0	T1	T2	T3	
Physico-Chemical analysis					
Carbohydrates%	53.76	57.33	56.46	53.84	0.597
Protein%	12.72	11.58	12.07	14.61	1.46
Fat%	28.62	25.14	24.67	24.18	0.10
Ash%	2.38	2.42	3.38	4.22	0.20
TS%	97.48	96.59	96.58	96.85	0.178
Moisture%	2.52	3.43	3.32	3.12	0.17

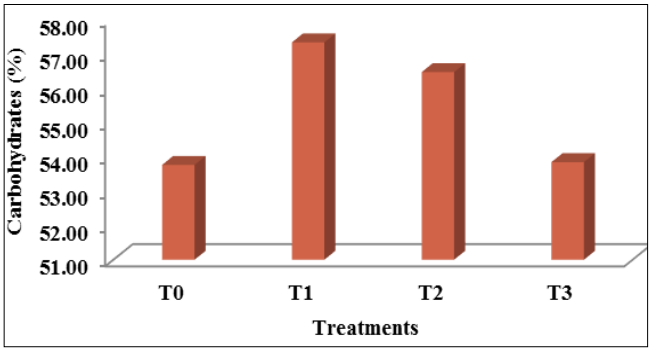


Fig 1: Average of data obtained on carbohydrates of fasting cookies

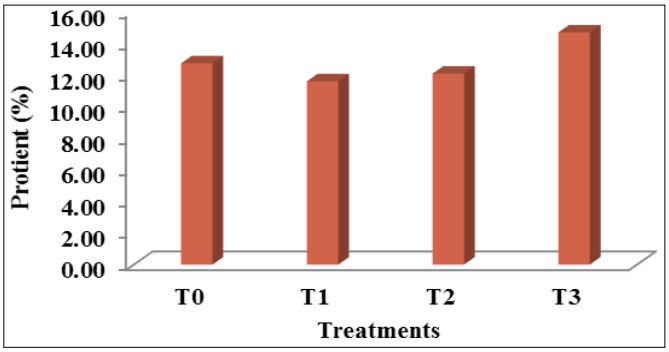


Fig 2: Average of data obtained on protein content of fasting cookies

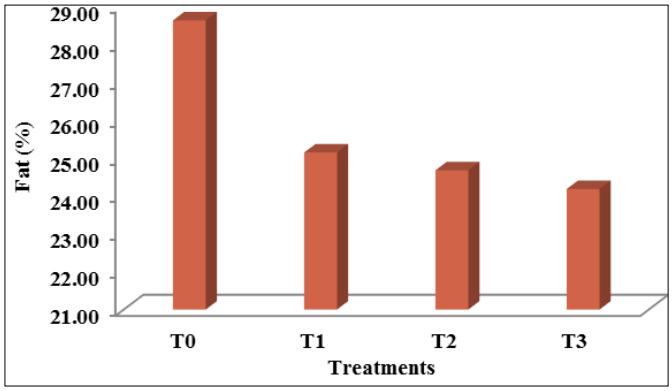


Fig 3: Average of data obtained on fat content of fasting cookies

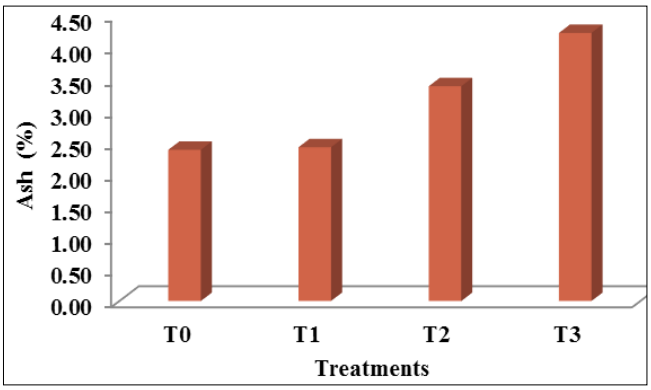


Fig 4: Average of data obtained on ash content of fasting cookies

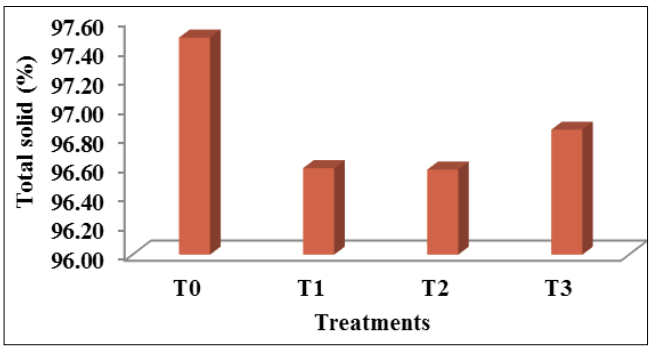


Fig 5: Average of data obtained on total solid of fasting cookies

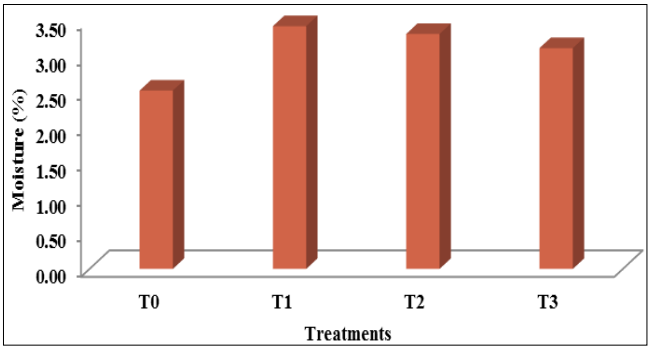


Fig 6: Average of data obtained on moisture content of fasting cookies

Minerals analysis of Fasting cookies

It can be observed from the table 4 and fig. 7 and 8 that average of minerals analysis in fasting cookies. The average of Iron (mg) in fasting cookies. T_0 (3.01), T_1 (4.52), T_2 (4.17) and T_3 (3.36). The highest average value of Iron (mg) (4.52) was obtained in the treatment T_1. The average of calcium (mg) in fasting cookies T_0 (54.69), T_1 (85.27), T_2 (87.95) and T_3 (90.66). The highest average value of calcium (mg) (90.66) was obtained in the treatment T_3.

Table 4: Minerals analysis of Fasting cookies

Parameter	**Score /value based on mean value of different parameter of treatment**				**C.D. value at 0.5%**
Treatments	T0	**T1**	**T2**	**T3**	
Mineral analysis					
Iron (mg)	3.01	4.52	4.17	3.36	0.06
Calcium (mg)	54.69	85.27	87.95	90.66	0.017

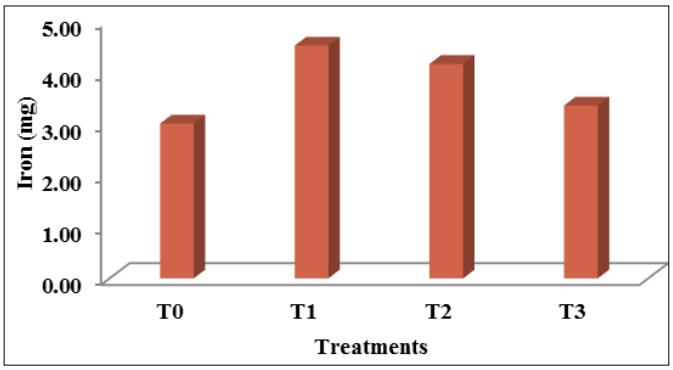


Fig 7: Average of data obtained on Iron (mg) of fasting cookies

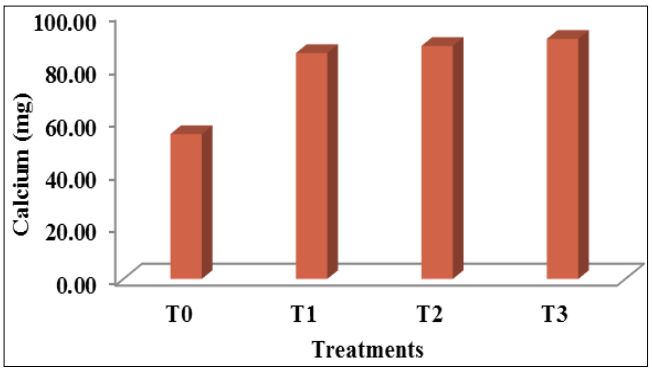


Fig 8: Average of data obtained on calcium (mg)of fasting cookies

Microbial analysis of Fasting cookies

It can be observed from the table 5 and fig. 9 and 10 that average of microbial analysis in fasting cookies. The average of $\times 10^{-3}$ (cfu/gm)in fasting cookies T_0 (7.60), T_1 (3.00), T_2 (7.80) and T_3 (2.20). The highest average value of SPC$\times 10^{-3}$ (cfu/gm) (7.80) was obtained in the treatment T_2. The average of Yeast and mould in fasting cookies T_0 (14.00), T_1 (6.00), T_2 (6.20) and T_3 (52.00). The highest average value of Yeast and mould (52.00) was obtained in the treatment T_3.

Table 5: Microbial analysis of Fasting cookies

Parameter	Score /value based on mean value of different parameter of treatment				C.D. value at 0.5%
Treatments	T0	T1	T2	T3	
Microbial analysis					
SPC$\times 10^{-3}$ (cfu/gm)	7.60	3.00	7.80	2.20	1.54
Yeast and mould (cfu/gm)	14.00	6.00	6.20	5.20	3.060
Coli form	Nil	Nil	Nil	Nil	Nil

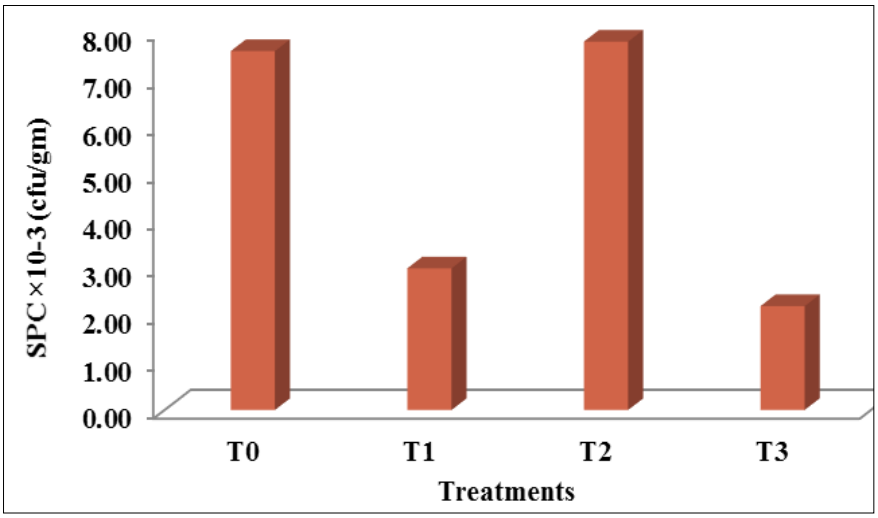


Fig 9: Average of data obtained on SPC$\times 10^{-3}$ (cfu/gm) count of fasting cookies

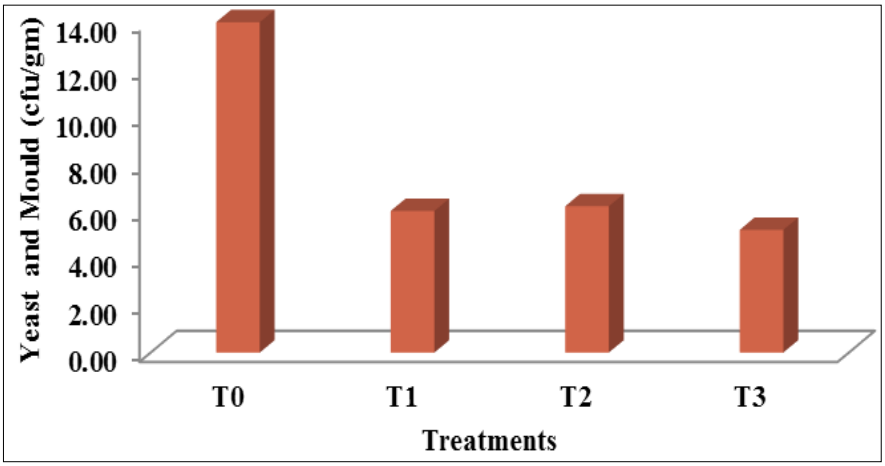


Fig 10: Average of data obtained on Yeast and mould of fasting cookies

Sensory attributes score of fasting cookies

It can be observed from the table 6 and fig. 11, 12, 13 and 15 that average of sensory attributes score in fasting cookies. The average of color and appearance score in fasting cookies T_0 (7.20), T_1 (8.40), T_2 (7.00) and T_3 (8.60). The highest average value of color and appearance score (8.60) was obtained in the treatment T_3. The average of flavor and taste score in fasting cookies. T_0 (7.20), T_1 (6.40), T_2 (5.80) and T_3 (8.20). The highest average value of flavor and taste score (7.20) was obtained in the treatment T_0. The average of Body and texture score in fasting cookies T_0 (6.20), T_1 (5.40), T_2 (6.60) and T_3 (8.40). The highest average value of Body and texture score (8.40) was obtained in the treatment T_3. The average of overall acceptability score in fasting cookies T_0 (7.40), T_1 (6.80), T_2 (7.40) and T_3 (7.00). The highest average value of overall acceptability score (7.40) was obtained in the treatment T_0&T_3.

Table 6: Sensory attributes score of fasting cookies

Parameter	Score /value based on mean value of different parameter of treatment				C.D. value at 0.5%
Treatments	T0	T1	T2	T3	
Sensory attributes					
Colour and appearance	7.20	8.40	7.00	8.60	1.19
Flavor and taste	7.20	6.40	5.80	8.20	1.21
Body and texture	6.20	5.40	6.60	8.40	1.64
Overall acceptability	7.40	6.80	7.40	7.00	1.58

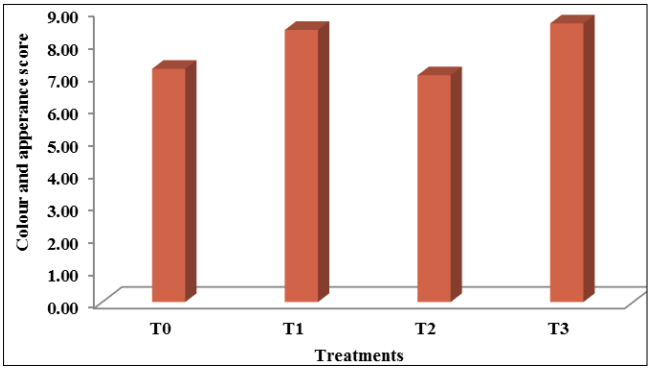


Fig 11: Average of data obtained on colour and appearance score of fasting cookies

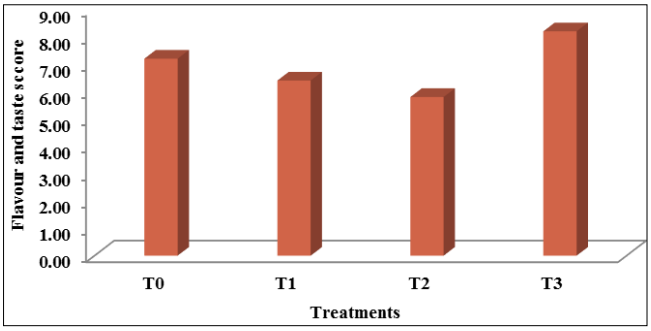


Fig 12: Average of data obtained on flavor and taste score of fasting cookies

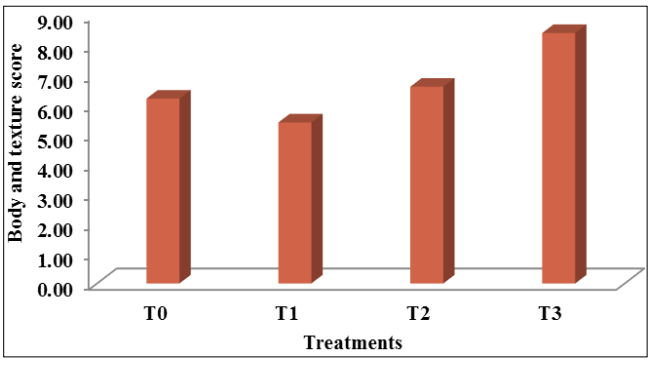


Fig 13: Average of data obtained on Body and texture score of fasting cookies

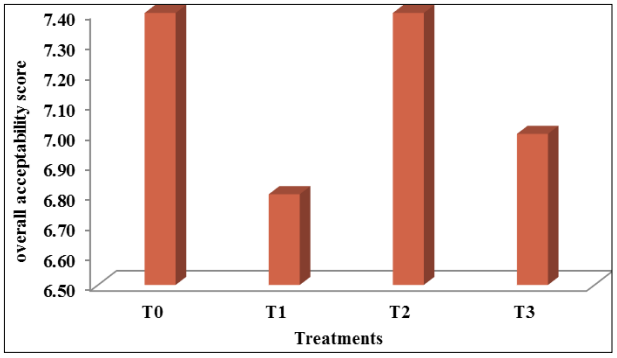


Fig 14: Average of data obtained on overall acceptability score of fasting cookies

Texture analysis of fasting cookies

It can be observed from the table 7 and fig.15 that average of harness in fasting cookies. The average of harness in fasting cookies T_0 (8657.82), T_1 (20817.76), T_2 (9993.16) and T_3 (6865.94). The highest average value of harness (20817.76) was obtained in the treatment T_1.

Table 7: Average of data obtained on Hardness score of fasting cookies

Parameter	Score /value based on mean value of different parameter of treatment				C.D. value at 0.5%
Treatments	T0	T1	T2	T3	
Texture analysis of fasting biscuit					
Hardness	8657.82	20817.76	9993.16	6865.94	8657.82

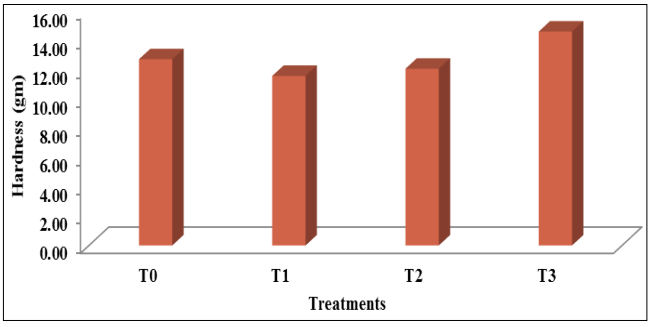


Fig 15: Average of data obtained on hardness score of fasting cookies

To- Fasting Cookies was prepared by 100% water chestnut flour.

Fig 16

T1- Fasting cookies was prepared by 50% water chestnut flour, 35% sweet potato flour & 15% Amaranth flour.

Fig 17

T2- fasting cookies was prepared by 60% water chestnut flour, 25% sweet potato four & Amaranth flour.

Fig 18

T3- Fasting cookies was prepared by 70% water chestnut flour 15% sweet potato flour & 15% Amaranth flour

Fig 19

Conclusion

The cookies prepared out of 70 g water chestnut 15 g sweet potato, and 15 g amaranth flour (T3) attains good sensory and textural properties with maximum acceptance during sensory analysis. Fasting cookies was prepared to asses nutritional quality associated with different ingredients, which can be used during fasting days to give health benefits and dense energy to the body. Study was conducted on different samples based on different samples based on different proportion of water chestnut flour, sweet potato flour amaranth flour. Sample T3 (70%15%15%) was the most acceptable and the best sample selected during sensory evalution on the basis of above results revealed in the presented study it might be conclude that this formulation of fasting cookies was possible to satisfy consumer taste and preferences and will be accepted in the market as fasting purpose.

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