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# Relative Study of Sensory Quality and Physico Chemical Properties of *Gulabjamun* Blended with Brown Rice (*Oryzae sativa*)

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**Abstract**

*Gulabjamun* is a popular indigenous sweet commodity, commonly prepared from the *khoa* in India. The present investigation entitled 'Studies on preparation of *Gulabjamun* Blended with Brown Rice *(Oryza sativa)'*. Studied for its sensory quality on various attributes such as flavour, body and texture, colour and appearance and overall acceptability by semi trained panelist using 9-point hedonic scale and physico chemical studies. The experimental treatments comprised without addition of brown rice flour *i.e.,* $T_0$, addition of brown rice flour as $T_1$, $T_2$, $T_3$, $T_4$. In all treatments, 750 gm dhap *khoa* was used for preparation of *gulabjamun* while 250 gm refined wheat flour was used for treatment $T_0$. For remaining treatments *i.e.,* $T_1$, $T_2$, $T_3$, $T_4$, by considering 250 gm of refined wheat flour as replaced by brown rice flour as per the treatment combinations. The colour and appearance, body and texture, flavour and overall acceptability ranged from 8.25 ($T_1$) to 8.70 ($T_0$), 8.10 ($T_1$) to 8.41 ($T_0$), 8.05 ($T_1$) to 8.52 ($T_0$) and 8.10 ($T_1$) to 8.50 ($T_0$) on the basis of 9-point hedonic scale, respectively. The treatment combination $T_0$ was at par to treatment $T_3$ which was scored higher in sensory evaluation and was considered as optimized product of *gulabjamun*. The sensorily best fresh *gulabjamun* samples had average chemical composition 12.32 per cent fat, 7.35 per cent protein, 22.37 per cent reducing sugar, 25.79 per cent non-reducing sugar, 48.16 per cent total sugar, 30.45 per cent moisture content, 1.67 per cent ash and 69.50 per cent total solids, respectively.

*Keywords* : *Gulabjamun*, Sensory evaluation, Physico-chemical properties, Refined wheatflour, Brown rice

*Gulabjamun* is a popular indigenous sweet commodity, commonly prepared from the *khoa. Dhap* variety of *khoa* having 40-45 per cent moisture is preferred for *gulabjamun* preparation. (Yawale and Rao, 2012). The most liked product should have brown colour, smooth and spherical shape, soft and slightly spongy body, free from both lumps and hard central core, uniform granular texture with cooked flavour and free from doughy feel and the sweet should be fully succulent with sugar syrup with optimum sweetness. (Harini & Rao, 2011 and Rai, 2000).

India continues to be the largest producer of milk in world. Milk production during 2020-21 and 2021-22 is 209.96 million tonnes and 221.06 million tonnes, respectively showing an annual growth of 5.29 per cent. The per capita availability of milk is around 444 g/day in 2021-22 (Annual Report, 2022-23). Milk is considered as nearly perfect food because it contains the wide array of nutrient and some bioactive components, however, it is deficient in certain micronutrients (iron, copper and certain vitamins) and dietary fiber (Shrivasta, 2010 and Kubade *et al*., 2023). Therefore, there is a need for supplementing the milk with a necessary micronutrients and health promoting components from suitable sources. In recent years, cereals and its ingredients are accepted as functional food and nutraceuticals because of providing dietary fiber, proteins, energy, minerals, vitamins and antioxidants required for human health. Considering

the constant health awareness of consumers towards the functional and healthy foods, the technology for cereal based products offers opportunities to fulfill the consumer acceptance. Brown rice contains 3.5 g of dietary fibre per 100 g (USDA, 2014). According toWHO, requirement of dietary fibre is 23-27 g/day and as per National Institute of Food Nutrient, it is 40-50 g/day. Incorporation of plant origin material, millets in milk or milk products, directly or indirectly adds dietary fibre in human food (Pascual *et al*., 2013; Choudhari & Khedkar, 2009 and Kubade *et al*., 2024) which influence on shelf life of dairy products (Kubade *et al*., 2024). Brown rice contains vital nutrients such as iron, zinc, thiamine, niacin, vitamin E, dietary fibre, protein and carbohydrates (Pascual *et al.,* 2013).

## Material and Methods

The whole, fresh, clean cow milk was procured from Research-cum-Development Project (RCDP), Department of Animal Husbandry and Dairy Science, MPKV, Rahuri.

$T_0$ *Khoa* + 100 per cent refined wheat flour + baking powder

$T_1$ *Khoa* + 75 per cent refined wheat flour + 25 per cent brown rice flour + baking powder

$T_2$ *Khoa* + 50 per cent refined wheat flour + 50 per cent brown rice flour + baking powder

$T_3$ *Khoa* + 25 per cent refined wheat flour + 75 per cent brown rice flour + baking powder

*Note* : To-750 gm *khoa* + 250 gm refined wheat flour *i.e.,* 100 per cent refined wheat flour

**Preparation of *gulabjanum* sample**

Receiving of cow milk
↓
Pre heating (38-40°C)
↓
Filtration/Clarification
↓
Standardization (4.5%fat)
↓
Boiling of milk in *karahi*
↓
Heating
↓
Continuous stirring- cum- scrapping with the help of *kunthi*
↓
*Khoa*
↓
Mixing of brown rice flour, refined wheat flour and *khoa* (as per treatments)
↓
Addition of baking powder (0.2%)
↓
Dough
↓
Portioning (8gm each portion)
↓
Ball forming
↓
Deep frying in iron karahi (In variable temperature.)
↓
Soaking (2-3hour) in sugar syrup (60%)
↓
Packaging (Polysterene cup)
↓
Storage at room temperature

### Analysis of the Product

### Sensory Evaluation of Fresh *Gulabjamun* Samples

The samples of *gulabjamun* were evaluated by the semi-trained panel of judges from division of Animal Husbandry and Dairy Science by using 9-point hedonic scale (Amerine *et al*., 1965).

### Physico-Chemical Analysis of Fresh *Gulabjamun* Samples

Fresh gulabjamun samples were analyzed for fat, protein, reducing sugar, non-reducing sugar, moisture, ash and moisture. Fat content of *gulabjamun* was determined as per the procedure described in AOAC (2002b). Protein content of *gulabjamun* was estimated byMicro-Kjeldhal method, AOAC (1992). Reducing sugar of *gulabjamun* sample were estimated by (Lane and Eynon method, 1923) with slight modification suggested by (Ranganna, 1986). Total sugar was determined by the method of (Lane and Eynon, 1923) as described by (Ranganna, 1986). Moisture content of *gulabjamun* was determined as per SP:18

(Part - XI), 1981. Ash and total solids content were determined by procedure describe din IS:1479 (Part- II), 1961.

## Results and Discussion

### Sensory Quality of *Gulabjamun* Samples

From Table 1 and Fig. 1, it was observed that, all sensory attributes *viz.,* colour and appearance, body and texture, flavour and overall acceptability of fresh *gulabjamun* samples under different treatment combinations were significant. The colour and appearance, body and texture, flavour and overall acceptability ranged from 8.25 ($T_1$) to 8.70 ($T_0$), 8.10 ($T_1$) to 8.4 ($T_0$), 8.05 ($T_1$) to 8.52 ($T_0$) and 8.10 ($T_1$) to 8.50 ($T_0$), respectively. The treatment combination $T_0$ was at par to treatment $T_3$. The treatment $T_0$ found sensorily superior over the rest of treatments followed by treatment $T_3$. In line with the study, Patil (2002) reported the score for overall acceptability ranged from 7.96 to 8.23 for formulation of *gulabjamun* from goat milk (Dewani & Jayaprakasha, 2002 and Rai, 2000) studied sensory characteristics of *gulabjamun* and reported the score for overall acceptability ranged from 6.50 to 8.16. (Thaware, 2011) reported the score for overall acceptability ranged from 7.58 to 8.24 for prepared *gulabjamun* by utilization of potato powder as substitute of *maida*. (Lingayat and Nalawade, 2014) reported the score for overall acceptability ranged from 8.66 to 7.70 and 8.62 to 8.30 for prepared *peda* and *gulabjamun* blended with wheat bran.

**Table 1**

**Sensory quality of fresh *gulabjamun* samples**

| Treatments | Colour & apperance | Body & Texture | Flavour | Overall Acceptability |
|---|---|---|---|---|
| $T_0$ | 8.70 $^{a}$ | 8.41 $^{a}$ | 8.52 $^{a}$ | 8.50 $^{a}$ |
| $T_1$ | 8.25 $^{c}$ | 8.10 $^{c}$ | 8.05 $^{c}$ | 8.10 $^{c}$ |
| $T_2$ | 8.35 $^{bc}$ | 8.20 $^{b}$ | 8.10 $^{c}$ | 8.20 $^{bc}$ |
| $T_3$ | 8.66 $^{a}$ | 8.38 $^{a}$ | 8.44 $^{a}$ | 8.45 $^{a}$ |
| $T_4$ | 8.45 $^{b}$ | 8.25 $^{b}$ | 8.30 $^{b}$ | 8.33 $^{b}$ |
| SE (m) | 0.10 | 0.06 | 0.04 | 0.05 |
| CD at 5% | 0.30 | 0.18 | 0.13 | 0.15 |

Mean score of 4 replication

### Physico-Chemical Quality of Fresh *Gulabjamun* Samples

*Fat :* Table 2 and Fig. 2, presents the fat content of *gulabjamun* samples for treatments $T_0$, $T_1$, $T_2$, $T_3$ and $T_4$ were 11.22, 11.79, 12.10, 12.32 and 12.90 per cent,

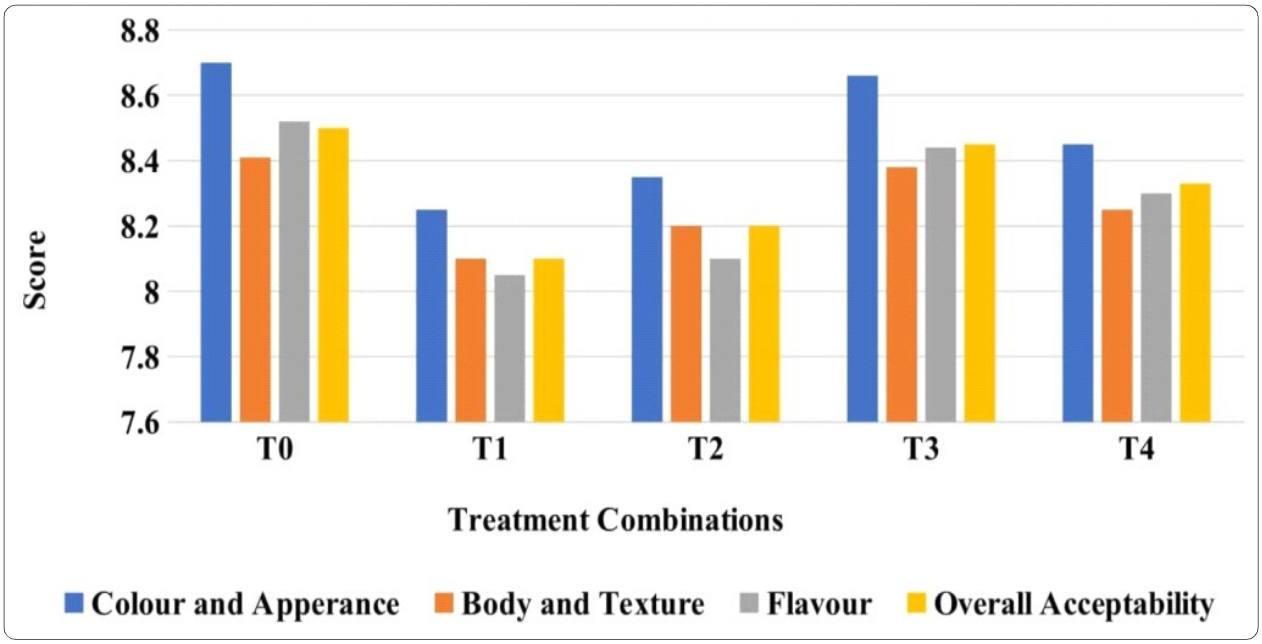


Fig. 1 : Effect of treatment combinations on sensory attributes of fresh *gulabjamun* samples

**TABLE 2**

**Physico- chemical quality of fresh *gulabjamun* samples**

| Treatments | Fat | Protien | Reducing sugar | Non-reducing sugar | Toatal sugar | Moisture | Ash | Total solids |
|---|---|---|---|---|---|---|---|---|
| $T_0$ | 11.22 $^{c}$ | 8.12 $^{a}$ | 22.42 $^{a}$ | 25.70 $^{e}$ | 48.12 $^{c}$ | 31.06 $^{a}$ | 1.43 $^{d}$ | 68.89 $^{e}$ |
| $T_1$ | 11.79 $^{d}$ | 7.82 $^{b}$ | 22.40 $^{b}$ | 25.73 $^{d}$ | 48.13 $^{bc}$ | 30.77 $^{b}$ | 1.44 $^{d}$ | 69.18 $^{d}$ |
| $T_2$ | 12.10 $^{c}$ | 7.64 $^{c}$ | 22.38 $^{c}$ | 25.76 $^{c}$ | 48.14 $^{b}$ | 30.56 $^{c}$ | 1.52 $^{c}$ | 69.40 $^{c}$ |
| $T_3$ | 12.32 $^{b}$ | 7.35 $^{d}$ | 22.37 $^{cd}$ | 25.79 $^{b}$ | 48.16 $^{a}$ | 30.45 $^{d}$ | 1.67 $^{b}$ | 69.50 $^{b}$ |
| $T_4$ | 12.90 $^{a}$ | 7.21 $^{e}$ | 22.36 $^{d}$ | 25.81 $^{a}$ | 48.17 $^{a}$ | 29.82 $^{e}$ | 1.85 $^{a}$ | 70.13 $^{a}$ |
| SE (m) | 0.04 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.003 |
| CD at 5% | 0.12 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.010 |

respectively. The fat content of *gulabjamun* samples were significantly (P<0.05) differed by addition of different level of brown rice flour. Treatment $T_4$ had highest fat per cent (12.90) whereas, the treatment $T_0$ had lowest fat per cent (11.22). This observation indicated that as the level of brown rice flour increased, fat content in *gulabjamun* samples also increased because of fat content in brown rice (2.8 %) was higher than refined wheat flour (1.74 %). The results agree with previous research workers, (Patel *et al.,* 2020) reported addition of amaranthus in *gulabjamun* increased fat content from 6.60 to 7.14 per cent, respectively. (Srivastava, 2010), (Sahana and Vijayalaxmi, 2022) recorded 12.28 to 14.08 per cent of fat in foxtail millet *gulabjamun*.

*Protein :* Table 2 and Fig. 2, presents the protein content of *gulabjamun* samples ranged between 7.21 to 8.12 per cent. The treatment $T_0$ (8.12) has significantly higher protein per cent than treatments

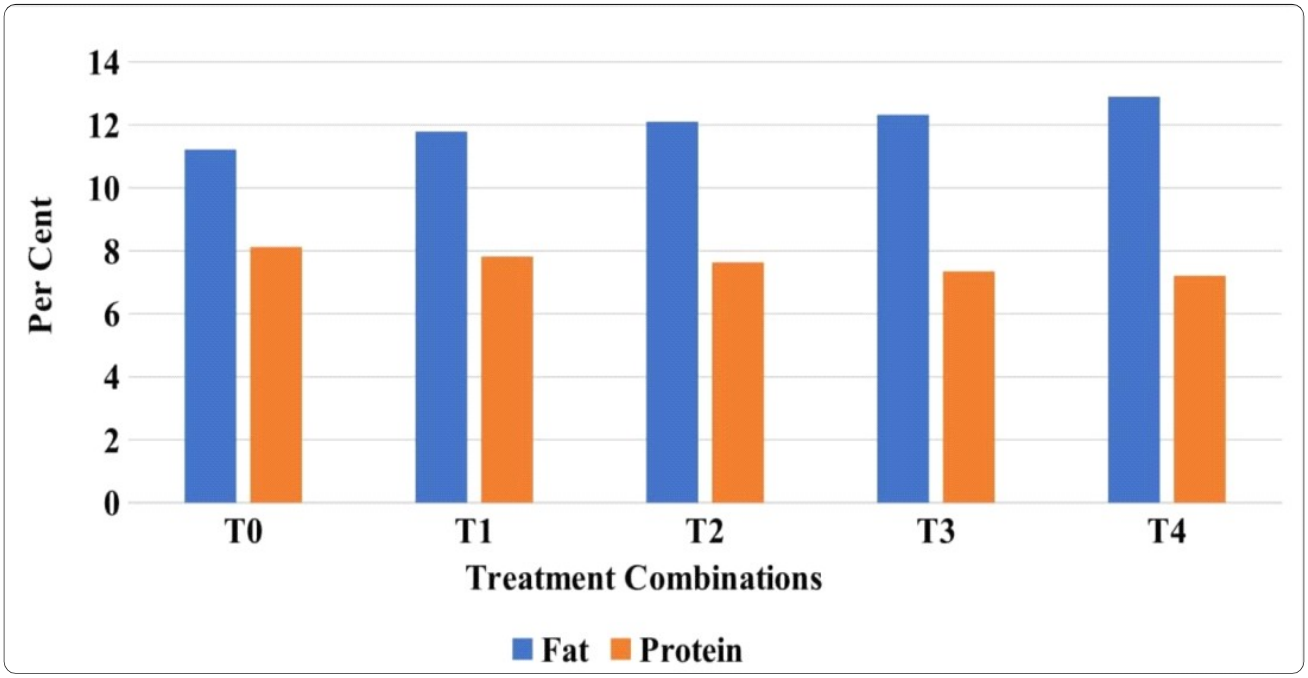


Fig. 2 : Effect of treatment combinations on fat and protein content of fresh *gulabjamun* samples

$T_1$ (7.82), $T_2$ (7.64) and $T_3$ (7.35) and $T_4$ (7.21). The protein content of *gulabjamun* samples decreased significantly (P<0.05) as the increased level of brown rice flour. This may be due to the low protein per cent (8.32) in brown rice than refined wheat flour (12.86). The results agree with previous research workers, (Choudhary, 2016) recorded a protein range in *gulabjamun* by addition of moriyo from 7.19 to 8.92 per cent. (Patel *et al.,* 2020) recorded 6.60 to7.14 per cent of protein in *gulabjamun* incorporated by amaranthus. (Sahana and Vijayalaxmi, 2022) recorded an increase of protein percent from 12.28 to 14.08 in *gulabjamun* as the level of foxtail millet increased.

*Reducing Sugar :* Table 2 and Fig. 3, it is revealed that reducing sugar content in *gulabjamun* samples decreased from treatment $T_0$ to $T_4$. This may be due to the reducing sugar content in brown rice (0.45 %) is slightly lower than wheat flour (0.61 %). Reducing sugar content of *gulabjamun* samples for treatment $T_0$, $T_1$, $T_2$, $T_3$ and $T_4$ was 22.42, 22.40, 22.38, 22.37 and 22.36 per cent, respectively. The result showed that highest reducing sugar per cent was recorded in $T_0$ (22.42) where as lowest reducing sugar per cent was recorded in treatment $T_4$ (22.36).

The above results are comparable with the findings of following research worker. (Dharm Pal, 1997), he reported that the reducing sugar per cent of *pedha* range from 4.00 to 20.60 per cent.

**Non-Reducing Sugar**

Data showed that non-reducing sugar per cent was significantly (P<0.05) lowest in treatment $T_0$ (25.70) where as highest non-reducing sugar per cent was recorded in treatment $T_4$ (25.81). The per cent of non-reducing sugar slightly increased as the level of brown rice flour increased. This could be attributed due to absorption of sugar syrup and higher soaking capacity of brown rice. The present findings are in accordance with (Sakate, 2004) for wood apple burfi.

*Total Sugar :* Table 2 and Fig. 3, presents all the treatments are significantly (P<0.05) differed from each other. Highest total sugar per cent was recorded in treatment $T_4$ (48.17) but at par with treatment $T_3$ (48.16). Treatment $T_0$ (48.12) showed lowest total sugar per cent. It was observed that total sugar content was found in increasing order for treatments $T_0$, $T_1$, $T_2$, $T_3$ and $T_4$ as 48.12, 48.13, 48.14, 48.16 and 48.17 per cent, respectively. This might be due to brown rice having high total sugar (75.14 %) as compared to

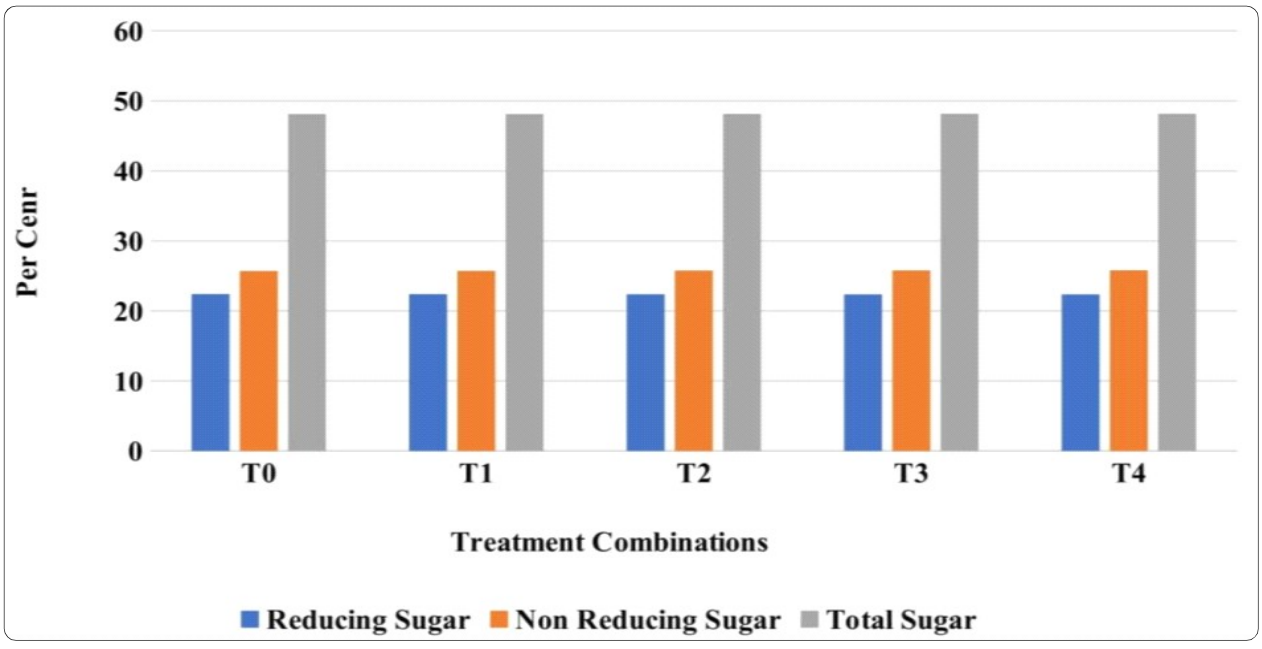


Fig. 3 : Effect of treatment combinations on reducing, non-reduing and total sugar content of fresh *gulabjamun* samples

refined wheat flour (74.6%). The values recorded for total sugar content in the present investigation were in accordance with the findings of (Rajorhia *et al*., 1989; Prajapati *et al*., 1991; Prajapati *et al.,*1994 and Yawale and Rao, 2012).

*Moisture* : Table 2 presents the moisture content of fresh *gulabjamun* samples was ranged between 29.82 to 31.06 per cent. Treatment $T_0$ (31.06 %) has significantly higher moisture content than other treatments. The per cent of moisture content decreased significantly (P<0.05) as the level of brown rice increased. This was because due to solute increased in *gulabjamun* sample, the moisture content decreased. (Sahana and Vijayalaxmi, 2022) recorded decreased of moisture per cent from 35.9 to 33.51 in *gulabjamun* as the level of foxtail millet increased.

*Total Solids* : Table 2 represents that total solids content of fresh *gulabjamun* samples ranged between 68.89 to 70.13 per cent. The result showed that highest total solids content was recorded in treatment $T_4$ (70.13 %) and lowest total solids per cent was recorded for treatment $T_0$ (69.18 %). It was noticed that as the per cent of brown rice flour increased there was significant increase in total solids content. It might be due to increased fat, total sugar and ash per cent in *gulabjamun* samples. The results are in agreement with previous research workers *viz.,* Choudhary (2016) reported addition of moraiyo in *gulabjamun* increased total solid content from 67.56 to 71.39 per cent, respectively. (Patel *et al.,* 2020) reported addition of amaranthus in *gulabjamun* increased total solid content from 66.15 to 71.29 per cent, respectively.

*Ash* : It is revealed that there was increased in ash content in fresh *gulabjamun* samples from treatment $T_0$ to $T_4$. Ash per cent of fresh *gulabjamun* samples for treatments $T_0$, $T_1$, $T_2$, $T_3$ and $T_4$ were 1.43, 1.47, 1.52, 1.67 and 1.85, respectively. Highest ash per cent was found intreatment $T_4$ (1.85 %). As the per cent of brown rice increased there is significant (P<0.05) increased in ash content could be due to brown rice contain various nutrients like iron, zinc, dietary fiber, etc. The results agree with previous research workers, increase in ash content due to addition moraiyo in *gulabjamun* (1.23 to 1.90) was also reported by (Choudhary, 2016 and Sahana & Vijayalaxmi, 2022) reported that addition of foxtail millet flour in *gulabjamun* increased ash content from 1.19 to1.28 per cent.

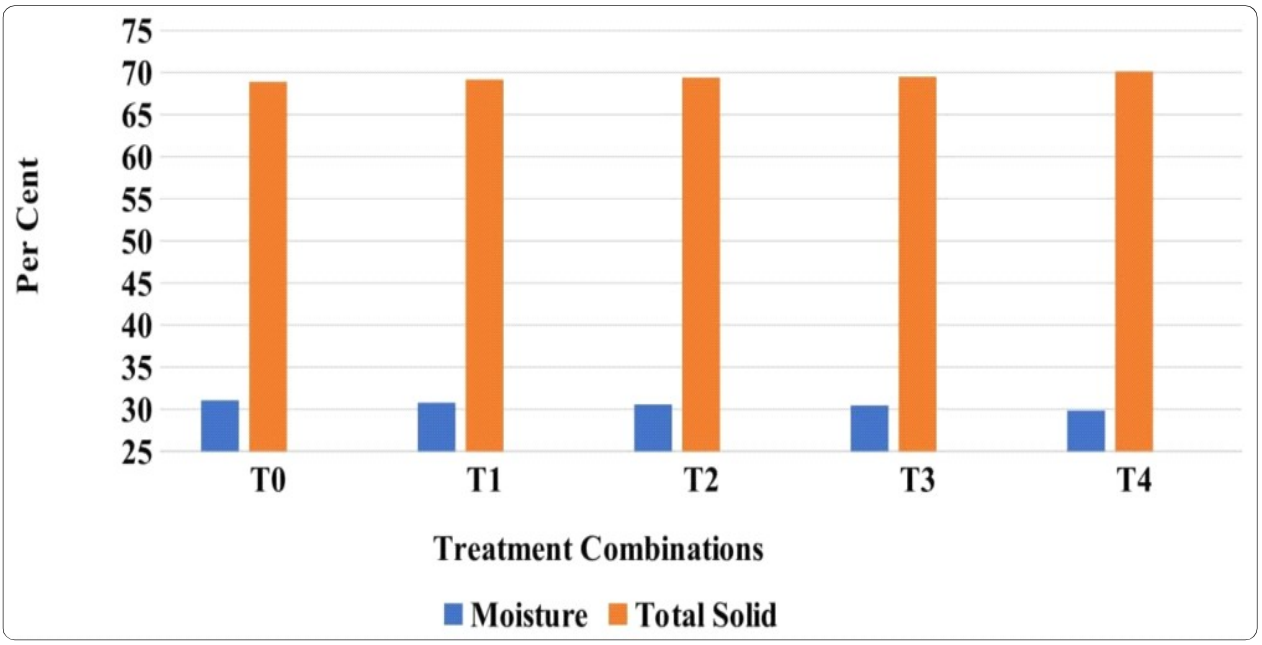


Fig. 4 : Effect of treatment combinations on moisture and total solids content of fresh *gulabjamun* samples

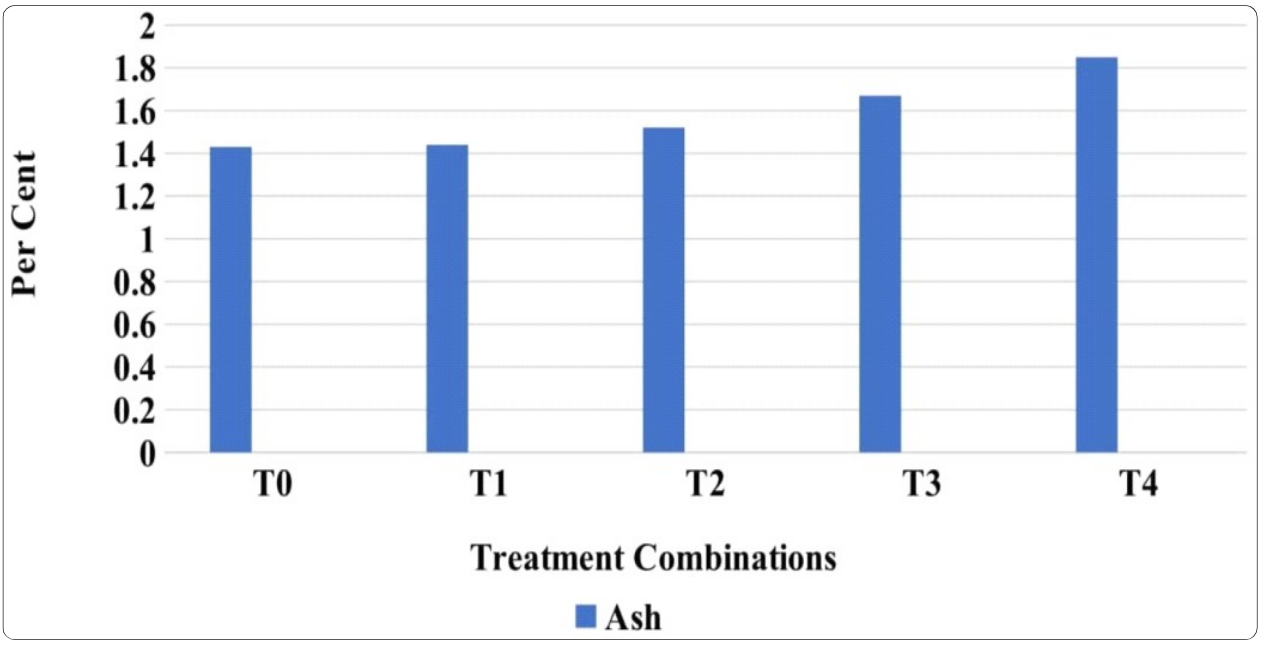


Fig. 5 : Effect of treatment combinations on ash content of fresh *gulabjamun* samples

From the above results it can be concluded that, the better quality *gulabjamun* was prepared by adding 25 per cent refined wheat flour and 75 per cent brown rice flour (overall acceptability score 8 .45). The sensorily best fresh *gulabjamun* samples had average chemical composition 12.32 per cent fat, 7.35 per cent protein, 22.37 per cent reducing sugar, 25.79 per cent non-reducing sugar, 48.16 per cent total sugar, 30.45 per cent moisture content, 1.67 per cent ash and 69.50 per cent total solids. In physico chemical properties it is concluded that as the percentage of brown rice increased, there was significant increase in fat, non-reducing sugar, total sugar, ash, total solids and decreased inprotein, reducing sugar and moisture content of *gulabjamun* samples.

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