



DEVELOPMENT OF FREE FLOWING DATE POWDER AND ITS UTILIZATION IN MUFFINS TO ENHANCE NUTRITIONAL VALUE

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ABSTRACT

A study was conducted at the Institute of Food Science and Nutrition, University of Sargodha, Sargodha, Pakistan during the year 2015. The study was designed to check the suitability of date powder in the composition of muffins. The muffins were prepared with different ingredients (flour, sugar, eggs, butter, milk, salt, baking powder and date powder). These muffins were tested at five treatments i.e. T₀ (muffins without date powder), T₁ (25% date powder + 75% sugar), T₂ (50% date powder + 50% sugar), T₃ (75% date powder + 25% sugar) and T₄ (100% date powder). The muffins were evaluated for physico-chemical, microbiological and sensory characteristics. The water activity of date muffins was in the range 0.733- 0.767. The color value in T₀ (0% date powder) was 163 CTn which was the lightest in color among all treatments while T₄ (100% date powder) with color value 126.5 CTn was the darkest among all treatments. The muffins in T₀ were found to have minimum softness in texture (maximum compression force) i.e. 1539.5 g as compared to muffins containing 100% date powder i.e. T₄ (868.5 g). The proximate analysis of muffins indicated that moisture, crude fibre and ash content differed significantly with the addition of date powder. The moisture contents of all treatments ranged from 26.35 to 34.08%. The crude protein contents for all treatments ranged from 11.46 to 15.14%. The protein, fibre and ash content gradually increased in muffins with the addition of date powder. Minimum gross energy value was observed in T₀ (476.4 kcal/100g) whereas the highest in T₄ (497.22 kcal/100g) The microbial analysis indicated that these muffins were microbiologically safe and can be kept for long time. The sensory analyses indicated that muffins with 50% replacement of sugar with date powder were liked the most by the judges.

KEYWORDS: Date powder; muffins; texture; color; water activity; nutritive value; Pakistan.

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INTRODUCTION

Fruits are very important in human nutrition due to presence of bioactive components like polyphenols, carotenoids and fibre, mineral elements and vitamins (Heo and Lee, 2005). Dates are considered as a nutritious fruit and improve nutritional value and sensory characteristics of any product in which these are added (Al-Hoote *et al.*, 1997). In Pakistan, abundant quantity of dates is produced in Sindh province especially in district Sakhar. In recent years the consumption of table dates is decreased and its utilization in food products has been increasing day by day like bars, paste, honey, jam, vinegar, cookies, wafers, squares and powder (Ahmad *et al.*, 2005). Date powder is very nutritious and its utilization in the development of value added products would be of great interest to researchers. Date powder contains considerable amount of invert

sugars especially fructose (Jagirdar, 1998). Date powder can be stored for long periods without quality deterioration. These can be utilized as a substitute for sugar in many food formulations by the industries throughout the year.

In Pakistan like majority of date producing countries, no work has been done for the value addition of dates and about 25-40% portion of fruits goes waste during post harvest handling. No data are available regarding the preparation and utilization of date powder in different food products in Pakistan.

In the existing situation of malnutrition practices, where children are affected due to prevalence of junk food, development of a nutritious muffins; replacing sugar with date powder is an excellent alternative to other snacks. Date muffins would

not only be a good alternative snack for children but also for working people to meet their energy and nutritional requirements.

The present project was planned keeping in view the nutritional requirements of children and workers. The objective was to develop free flowing date powder and its utilization in muffins to enhance nutritional value.

MATERIALS AND METHODS

This study was conducted at the Institute of Food Science and Nutrition, University of Sargodha, Sargodha, Pakistan during the year 2015. Commercially available wheat flour (maida), dates, sugar, ghee, eggs, salt and milk were purchased from the local market of Sargodha. The date powder was prepared following procedure given by Sablani *et al.* (2008) with some modification. Dates were pitted and washed. Pitted dates were

cut into small pieces before steaming and placed in baking trays. These trays were loaded into the oven and then dried at low temperature at 65 °C for 24 hours. After drying, the dates were ground in a locally made heavy duty grinder. In order to get fine and free flowing powder, 50% Maltodextrin and 4% Tricalcium phosphate were also added during grinding process. After grinding, date powder was packed air tight packaging. Table 1 shows the proportions of ingredients whereas variable formulations of date powder in muffins have been shown in Table 2.

Table 1. Formulation of date based muffins

Ingredients	Quantity
Flour	500 g
Sugar	275 g
Eggs	4 No
Butter	275 g
Milk	50 mL
Salt	2 g
Baking powder	15 g
Date powder	As per Table 3.2

Table 2. Variable formulations of date powder in muffins (Treatment plan).

Treatments	Date powder (g)				
T ₀	-				
T ₁		69			
T ₂			138		
T ₃				206	
T ₄					275

Procedure for preparation of date muffins

Date muffins were prepared according to the procedure given by Yaseen *et al.* (2012) with some modification. Cream was prepared by mixing icing sugar and butter. Eggs were beaten separately and mixed in the cream. Then baking powder was sifted with the flour and mixed in the cream slowly till homogenous batter preparation. The muffin tray was greased with oil and then batter was poured into the pans and baked in an oven at 180 °C for 35 minutes. These muffins were tested at five treatments i.e. T₀ (muffins without date powder), T₁ (25% date powder + 75% sugar), T₂ (50% date powder + 50% sugar), T₃ (75% date powder + 25% sugar) and T₄ (100% date powder) as indicated in Table 2. These date based muffins were subjected to physico-chemical analyses to assess the physical and chemical properties and also proximate composition of muffins.

Physical analysis

Water activity (aw unit): Water activity in date muffins was measured by following the procedure given by Nadeem *et al.* (2011) with water activity meter (Model Aw-Win, Rotronic).

Texture analysis: Texture (firmness/softness) of the muffins was analyzed by texture analyzer (Model TA.XT plus, Stable Microsystems, Surrey, UK) with 5 kg load cell according to the method described by Nadeem *et al.* (2012). Texture determinations were made using compression platen (P-75 mm). The muffins were compressed upto 50% to check firmness/softness. Muffins for test were placed centrally under the compression platen. Firmness/softness was analyzed by placing muffins under the compression platen and compression was measured by plotting force (g)

versus distance (mm). The measurement of force (g) was used for an index of firmness/softness for compression test.

Color measurement: Color of muffins was determined by following the method described by Nadeem et al. (2011) with the help of color meter (colortest II, Neohaus Neotec). The color meter was calibrated with standards 151 CTn (light color) and 54 CTn (dark color). The samples were placed centrally under photocell of color meter. The reading of the color meter was noted and compared with that of standards.

Chemical analysis

Chemical composition such as moisture, protein, fat, fibre and ash of muffins was determined by following the procedures given in AACC (1999).

Gross energy of muffins

Gross energy of muffins was calculated multiplying the protein, lipid and carbohydrates using standard factors of 3.75, 9.0 and 3.75 kcal/g, respectively. The energy contents were summed to give total or gross energy of the muffin samples (Livesey, 1990).

Microbiological analysis

Total plate count was analyzed following the method No. 42-11 of AACC (1) and mold/yeast count according to method No. 42-50 of AACC (1).

Sensory evaluation

Muffins were evaluated for sensory characteristics on 9-points Hedonic Scale (Land and Shepherd, 1988).

Statistical analysis

Data obtained from each attribute were statistically analyzed by using analysis of variance technique through Minitab. The difference in means was evaluated by LSD test (Steel et al., 1997). The normal distribution of all the data was checked by Shapiro-Wilk test through Minitab.

RESULTS AND DISCUSSION

Physical analysis of muffins

Water activity of muffins: The results showed an increasing trend in water activity from T_0 (0.733) to T_4 (0.767) (Fig. 1). This increase in water activity might be due to the quantity of date powder as control contains no date powder and T_4 contains 100% date powder as recipe sugar replacer. Being hygroscopic dates absorb more moisture and hence more water is available in free form.

These results of water activity are confirmed by earlier findings. Bhaduri (2013) prepared two gluten free flour muffins and analyzed for their physical and chemical properties. He observed that water activity decreased with increasing the amount of gluten free flour in the muffins i.e. 0.862 ± 0.015 to 0.816 ± 0.010 . Similarly, Rehman et al. (2012) prepared fruit bars with different concentration of apricot pulp and date paste. They reported that water activity increased (i.e. 0.534 to 0.546) with increasing the proportion of dried apricot paste in fruit bars.

Color of date-muffins: The mean color value in T_0 was 163 ± 1.41 CTn (color test number) which was significantly higher than T_1 , T_2 , T_3 and T_4 having values of 154 ± 1.41 , 148.5 ± 0.71 , 140 ± 1.41 and 126.5 ± 0.71 CTn, respectively (Fig. 1). Higher color values depicted lighter color and vice versa. T_0 having values of 163 ± 1.41 CTn was lightest in color among all treatments while T_4 with color score 126.5 ± 0.71 CTn was the darkest among all treatments that is due to the increase in date powder from T_0 (0% date powder) to T_4 (100% date powder).

These results are in line with the findings of Rehman et al. (2012). They reported that color values decreased from 129.62 to 127.86 CTn in apricot date bars. They observed that color values increased due to increasing quantity of dried apricot paste in fruit bars. The color became darker in T_4 due to maximum ratio of dried apricot paste. Similar trend of increasing in color was observed in the present study.

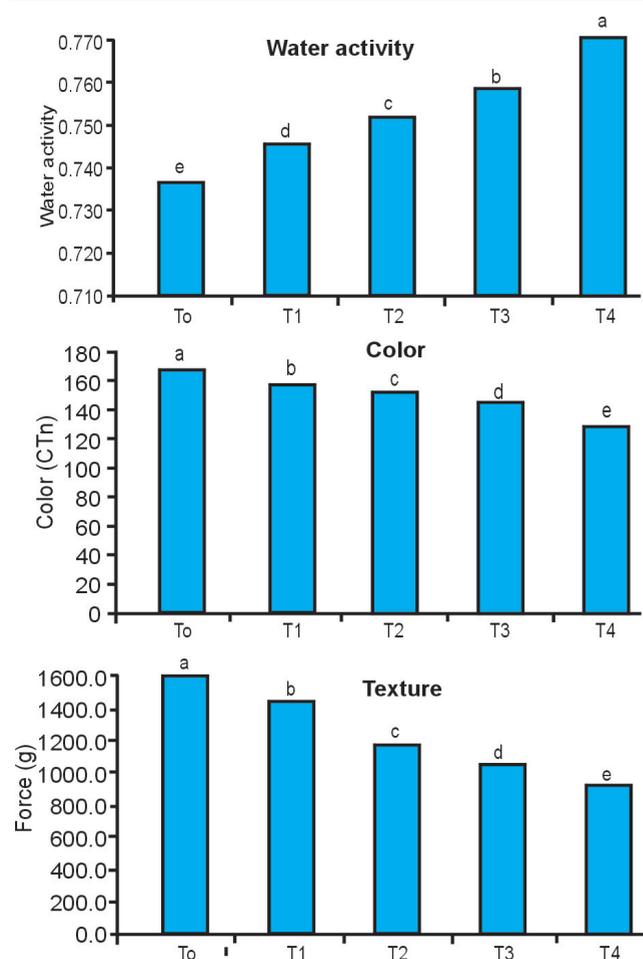


Fig. 1. Mean values for water activity, color and texture of muffins. [T₀ = Muffins without date powder; T₁ = 25% date powder + 75% of Sugar; T₂ = 50% date powder + 50% of sugar; T₃ = 75% date powder + 25% sugar; T₄ = 100% date powder.]

Texture of muffins: The muffins containing zero date powder (T₀) had minimum softness in texture (maximum compression force) i.e., 1539.5±7.78 g when compared with the muffins containing 100% date powder i.e. T₄, (868.5±4.95 g). Differences were observed in the texture of date muffins at every level of sucrose replacement (Fig. 1). The

use of date powder seems to be a very useful option for producing date muffins with soft texture. The reason for the softness might be the higher amount of fibre in date powder and fructose (well known humectant) in date powder that has more water absorption/holding capacity.

These results of instrumental texture of muffins are in line with the previous findings. Bhaduri (2013) prepared muffins by utilizing two types of gluten free flour and analyzed for their instrumental texture properties. He concluded that hardness decreased with increasing the amount of gluten free flour in the muffins. He observed texture values in the range of 868.27 ± 20.33 g to 1478.28 ± 30.46 g. Similarly, Rehman *et al.* (2012) prepared fruit bars with different concentration of apricot pulp and date paste. They reported that hardness decreased (i.e. 420.52 g to 315.58 g) with increasing the proportion of dried apricot paste in fruit bars.

Chemical analysis of muffins

The mean values of moisture content ranged from 26.35±0.07% to 34.08±0.07%, having highest score for T₄ and lowest score in T₀ (Table 3). With the addition of date powder moisture content increased among the treatments.

The protein content for treatments ranged from 11.46±0.13% to 15.14±0.04%, highest score for T₄ and lowest score for T₀. With the addition of date powder, protein content increased slightly because date powder has some quantity of protein (Table 3).

The mean values of crude fat for treatments ranged from 20.75±0.36% to 22.33±0.76%, highest score for T₄ and lowest score for T₀.

Table 3. Mean values ± SD for chemical composition of muffins.

Treatment	Moisture	Protein	Fat	Fibre	Ash	NFE
T ₀	26.35±0.07e	11.46±0.13e	20.37±0.36e	0.33±0.03e	1.43±0.02e	66.03±0.44a
T ₁	28.28±0.23d	13.18±0.37d	20.75±1.20d	0.67±0.03d	1.73±0.01d	61.67±1.53b
T ₂	30.16±0.02c	13.85±0.16c	21.49±0.34c	1.01±0.03c	2.12±0.00c	58.53±0.36c
T ₃	32.27±0.14b	14.39±0.32b	21.91±3.15b	1.36±0.05b	2.55±0.03b	56.29±3.41d
T ₄	34.08±0.07a	15.14±0.04a	22.33±2.76a	1.85±0.04a	2.84±0.03a	23.54±2.70e

T₀ = Muffins without date powder; T₁ = 25% Date powder + 75% of sugar; T₂ = 50% Date powder + 50 % of sugar; T₃ = 75% Date powder + 25 % sugar; T₄ = 100% Date powder

The mean values of crude fibre for treatments ranged from $0.33 \pm 0.03\%$ to $1.85 \pm 0.04\%$, highest score for T_4 and lowest score for T_1 . The fibre content increased with the addition of date powder in the muffins because dates are good source of fibre. Yaseen *et al.* (2012) reported that crude fiber content in the treatment increased with the addition of date bran in the muffins (i.e. 1.33 to 5.63%). The results of present study are close to these earlier findings.

The ash content ranged from $2.84 \pm 0.03\%$ to $1.43 \pm 0.02\%$, highest score for T_4 and lowest score for T_0 (Table 3). The ash content gradually increased due to the addition of date powder. Yaseen *et al.*, (2012) observed that ash content increased from 0.96 to 1.61% with the addition of date bran in the muffins.

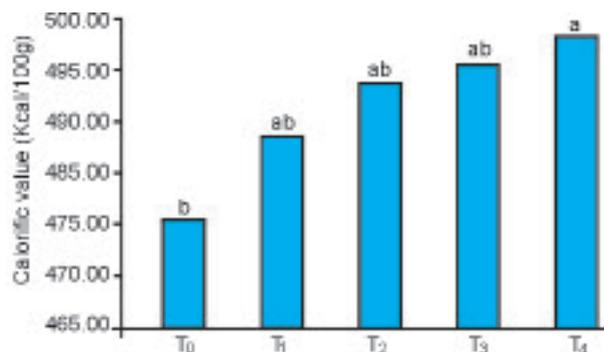


Fig. 2. Mean calorific values of muffins. (T_0 = Muffins without date powder; T_1 = 25% Date powder + 75% of sugar; T_2 = 50% Date powder + 50% of sugar; T_3 = 75% Date powder + 25% sugar; T_4 = 100% Date powder).

The means for NFE content of date muffins were $66.03 \pm 0.44\%$, $61.67 \pm 1.53\%$, $58.53 \pm 0.36\%$, $56.29 \pm 3.41\%$ and $53.54 \pm 2.70\%$ for T_0 , T_1 , T_2 , T_3 , and T_4 , respectively (Table 3). The lowest NFE

value was observed in T_4 ($53.54 \pm 2.70\%$) and the highest in T_0 ($66.03 \pm 0.44\%$). Similar decreasing trend in NFE content was reported by Yaseen *et al.* (2012). They reported that NFE content decreased from 23.24% to 20.97% in muffins prepared with the addition of date bran. These results further confirm the findings of Rehman *et al.* (2012) who found that NFE content decreased from 72.81% to 71.49% in apricot fruit bar.

Gross energy of muffins

The mean values of gross energy of different treatments (Fig. 2) were 476.4 ± 1.96 , 485.42 ± 6.60 , 491.86 ± 1.69 , 493.73 ± 16.75 and 497.22 ± 14.60 kcal/100g, for T_0 , T_1 , T_2 , T_3 , and T_4 , respectively. The lowest gross energy value was observed in T_0 (476.4 ± 1.96 kcal/100g) and the highest in T_4 (497.22 ± 14.60 kcal/100g). The highest energy value in T_4 might be due to more protein and fat content in the treatment. The values obtained in this study were higher than those found by Zahra *et al.* (2014) who calculated that nutri bars provided 339.615 kcal/100 g of energy.

Total plate count (TPC) of muffins

The TPC content of muffins were $1.74 \text{ Log}_{10} \text{ cfu/g}$, $1.78 \text{ Log}_{10} \text{ cfu/g}$, $1.82 \text{ Log}_{10} \text{ cfu/g}$, $1.86 \text{ Log}_{10} \text{ cfu/g}$ and $1.86 \text{ Log}_{10} \text{ cfu/g}$ for T_0 , T_1 , T_2 , T_3 , and T_4 , respectively. The mean values for treatments ranged from 1.74 to 1.90 $\text{Log}_{10} \text{ cfu/g}$ having highest score in T_4 and lowest score in T_0 . The TPC also varied highly significantly ($p \leq 0.01$) with storage period. The mean values changed from $1.64 \text{ Log}_{10} \text{ cfu/g}$ to $2.10 \text{ Log}_{10} \text{ cfu/g}$ during storage period of 30 days (Fig 3).

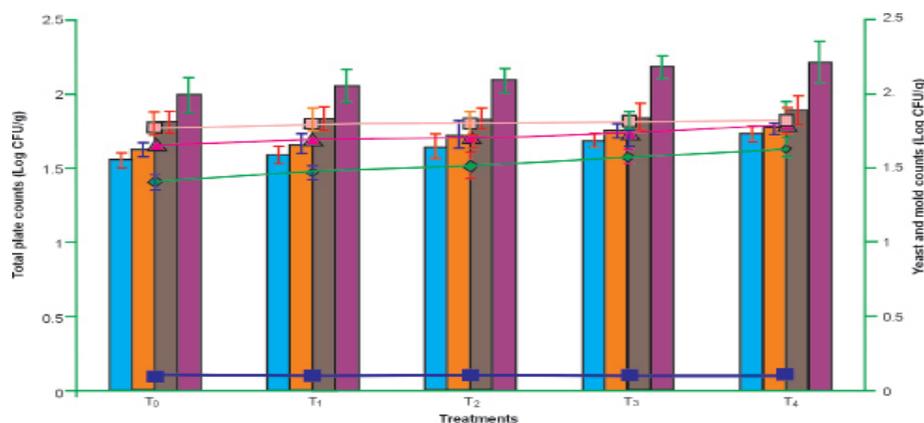


Fig. 3. Total plate counts ($\text{Log}_{10} \text{ cfu/g}$) and yeast and mould count ($\text{Log}_{10} \text{ cfu/g}$) of muffins during storage. Blue bars and lines show results after 1 day; Red bars and lines show results after 10 days; Green bars and lines show results after 20 days and purple bars and lines show results after 30 days.

Mold count of muffins

The mean values of mold growth are 1.21 Log₁₀ cfu/g, 1.24 Log₁₀ cfu/g, 1.26 Log₁₀ cfu/g, 1.28 Log₁₀ cfu/g and 1.31 Log₁₀ cfu/g for T₀, T₁, T₂, T₃, and T₄, respectively. The mean values for treatments ranged from 1.21 to 1.31 Log₁₀ cfu/g having highest score in T₄ and lowest T₁ (1.21 Log₁₀ cfu/g) followed by T₂ (1.43 Log₁₀ cfu/g). The mold count also varied highly significantly ($p \leq 0.01$) with storage period. The mean values changed from 0 to 1.80 Log₁₀ cfu/g during storage period of 30 days (Fig 3).

Sensory evaluation of muffins

Sensory evaluation is a scientific technique to

analyze the sensory properties and quality of product by using human senses. The results in Table 4 delineated the mean values of various treatments of muffins attributed for different sensory parameters. The results showed that mean values of color of muffins decreased from 8.18 to 5.85 during storage periods of 30 days. Minimum mean color value was attained by T₀ (5.85) whereas, maximum scores by T₂ (8.18) during storage. The flavor scores of muffins also varied from 5.55 to 7.37. T₀ had minimum flavor score i.e. 5.55 while T₂ had maximum value i.e. 7.37. Mean values of flavor was also affected and decreased during 30 days of storage period.

Table 4. Mean Values of sensory evaluation of date muffins (score).

Treatments	Storage time	Colour	Flavour	Taste	Mouth Feel	Volume	Body & Texture	Overall acceptability
	Day 1							
T ₀		6.48	6.59	7.53	6.74	6.85	6.96	6.72
T ₁		7.46	7.50	6.05	7.48	7.58	7.50	7.50
T ₂		8.18	8.17	8.19	7.93	7.87	8.01	8.25
T ₃		7.48	7.03	6.92	6.82	6.76	6.71	6.84
T ₄		7.09	7.03	7.18	7.01	7.22	7.51	6.99
	Day 15							
T ₀		6.11	6.04	7.34	6.03	5.92	6.14	6.06
T ₁		7.31	7.30	6.05	7.27	7.31	7.27	7.35
T ₂		8.03	7.87	7.82	7.92	8.06	7.87	8.07
T ₃		6.80	6.84	6.82	6.85	6.95	6.85	6.93
T ₄		6.72	6.71	6.70	6.79	6.76	6.74	6.78
	Day 30							
T ₀		5.85	5.55	6.85	5.70	5.66	5.44	5.98
T ₁		6.96	6.96	5.48	6.96	7.17	6.75	7.35
T ₂		8.18	7.37	7.22	7.25	7.62	7.44	7.81
T ₃		6.96	6.57	6.39	6.85	6.66	6.42	6.69
T ₄		6.55	6.57	6.77	6.79	6.33	6.22	6.03

The mean values of taste of these treatments also showed the decreasing trend during storage. The results depicted that mean values of these treatments of muffins were decreased from 7.22-5.48 in 30 days of study. Minimum score (5.48) for taste was obtained in T₁ while T₂ had maximum taste value (7.22) obtained during this period.

Similarly, a decreasing trend has also been observed in mouth feel of various muffins samples, ranging from 5.70 to 7.25. T₀ achieved minimum mouth feel (5.70) score while T₂ had maximum score (7.25). Mean values of mouth feel score decreased from 5.70 to 7.25 during storage periods of 30 days. Maximum volume score was obtained in T₂ (7.62) and T₁ (7.17) after 30 days of storage. Volume score for all treatments was

maximum at 1st day and was found minimum at 30th days.

Similarly, after 30 days of storage the texture of various treatments of muffin was also affected. The results delineated that T₂ showed less change in mean values followed by T₁ i.e. 7.44 and 6.75, respectively. The overall acceptability of various treatments was also affected and showed decreasing trend during storage. After 30 days of storage, the minimum change in overall acceptability was observed in T₂ i.e. 7.81 followed by T₁ i.e. 7.35.

The results of various parameters of sensory evaluation of muffins showed a significant variation in mean values, whereas the treatment T₂ has

attained the maximum scores and experienced a lesser change as compared to other treatments during 30 days of storage. Almost similar results have also been found by Bhaduri (2013) who analyzed sensory properties of muffins prepared from gluten free flours.

CONCLUSION

It is concluded that dates can be converted into powder form with good physical, nutritional and sensory properties. Date powder is a good substitute for sugar in bakery products and table sugar can be replaced upto 50% in bakery products. This will not only improve the physical characteristics but also nutritional and sensory properties in dairy products, confectionary and snacks. It may also be recommended for food formulations for diabetic patients.

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CONTRIBUTION OF AUTHORS

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Muhammad Mushtaq Ahmad	Helped in write-up
Mian Nadeem Riaz	Helped in planning and execution of research project
Ammara Ameer	Conducted experiment and performed analysis
Qurat ul An	Helped in literature review and wrote first draft of article