CHAPTER IV
RESULTS

4.1 PROXIMATE ANALYSES OF KIDNEY BEAN VARIETIES

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After the data collection, begins the task of data analysis and interpretation. This chapter presents the results of the study, wherein the unintelligible mass of data has been given some significant and understandable form and then thoroughly analyzed. Analysis is hardly complete without interpretation coming into play and, therefore, all the figures and facts have been explained in the context of theory on which the study was based in the preceding chapters. The aim of this endeavor has been to assess proximate principles, minerals, antioxidant and antinutrients of kidney bean varieties namely red kidney beans (RSJ-178), white kidney beans (HUR-15) and pinto beans (PDR-14) along with the effect of processing treatments such as hot-water blanching, on above parameters. The study also included food product development taking up sensory evaluation of the various products prepared by the incorporation of raw and processed forms of kidney bean flours and in whole forms in different proportion. The results have been presented as under-

4.1 PROXIMATE ANALYSES

Proximate analyses of raw and processed form of kidney bean varieties was done and results shown in Fig. 4.1.1 and 4.1.2 respectively. Moisture content of raw samples of kidney bean varieties viz. Red kidney beans (RKB), White kidney beans (WKB) and Pinto beans (PB) was found to be 12.3±0.43, 11.8±2.68 and 11.1±1.29g/100g respectively. The results indicated that moisture content increased significantly in blanched samples with values 13.2±0.36, 12.9±2.34 and 13.6±0.96g/100g for RKB, WKB and PB respectively. It was found that the higher level of moisture content in blanched beans vis-à-vis raw kidney beans is due to blanching treatment involving water.

Ash content in raw samples of kidney beans i.e. RKB, WKB and PB was 3.6±0.36, 2.0±0.30 and 3.7±0.2g/100g respectively. After processing, the ash content decreased significantly in blanched samples of the three varieties to 3.2±0.79, 1.4±0.26 and 2.5±0.78g/100g for RKB, WKB and PB respectively. Ash content of these kidney beans varieties seemed to be variety specific.

Fat content of raw RKB, WKB and PB was 1.5±0.2, 1.4±0.41 and 2.5±0.58g/100g respectively. The results registered insignificant variation in the
values of fat content of 1.3±0.1, 1.3±0.32 and 2.1±0.61g/100g in the three varieties respectively after blanching treatment. Fat content of the kidney bean varieties is small making these beans a foodstuff with positive nutritional implications. Further processing doesn’t change significantly.

Fiber content of raw RKB, WKB and PB was 4.0±0.34, 5.3±0.7 and 5.7±1.4g/100g respectively and after blanching treatment it was found to be decreased significantly to 3.6±0.38, 4.2±0.49 and 5.5±1.42g/100g for RKB, WKB and PB respectively.

Since legumes are a good source of protein and, in the same vein, kidney beans protein content stood at 23.6±1.18, 26.8±1.2 and 20.5±2.45g/100g in raw samples for RKB, WKB and PB respectively. Even after blanching, the difference in the protein content of these varieties became negligibly small, standing at 21.7±1.50, 23.1±1.08 and 19.6±1.70g/100g for RKB, WKB and PB respectively. It was seen that processing treatment significantly decreased the protein content of WKB blanched samples.

It was found that carbohydrate content of raw samples of RKB, WKB and PB was 56.7±3.61, 55.7±6.67 and 60.1±3.37g/100g respectively, while after blanching, the same increased significantly in three kidney bean varieties, to 62.7±5.0, 60.6±5.65 and 58.9±2.15g/100g respectively.

**Figure 4.1.1** Mean level of proximate principles in raw form of kidney bean varieties
4.2 MINERAL ANALYSES

Results of mineral analyses of kidney bean varieties have been shown in Fig: 4.2.1 and 4.2.2 respectively. Its total ash content encompasses minerals of considerable nutritional importance. It was found that calcium content of raw samples of RKB, WKB and PB was 221±58.28; 208±47.69 and 261.6±5.68mg/100g respectively. Mineral analyses of processed forms of kidney bean varieties revealed that calcium content increased significantly to 235.6±55.51, 221.0±46.86 and 270.0±5.56mg/100g in RKB, WKB and PB respectively. The results indicated that the values for calcium content increased possibly due to the fact thus the outer covering that got removed in the processing action might have been low in calcium content. These kidney bean varieties could prove a good source of calcium as compared to other varieties of legumes.

Iron content of raw samples of RKB, WKB and PB was 5.3±0.31, 8.0±0.79 and 6.6±0.32mg/100g respectively. After the application of processing treatments, the iron content was found to be increased significantly in the three varieties i.e. RKB, WKB and PB to 6.0±0.1, 8.4±0.88 and 6.9±0.20mg/100g respectively. The values for iron content increased possibly due to the fact thus the outer covering that got removed in the processing action might have been low in iron content. The kidney bean varieties could became good source for providing iron and helpful in overcome nutritional deficiencies of calcium and iron.
The results showed that phosphorus content of raw RKB, WKB and PB was 408±4.35, 426±89.06 and 412.33±112.05 mg/100g respectively. After processing, the phosphorus content of the blanched samples of three varieties stood at 415±5.29, 433.3±89.47 and 431.66±109.69 mg/100g for RKB, WKB and PB respectively. The data showed that the phosphorus content in three varieties of kidney beans was increased significantly after blanching treatment.

![Figure 4.2.1](image1.png)  
**Figure 4.2.1** Mean level of calcium and phosphorus in raw and processed forms of kidney bean varieties

![Figure 4.2.2](image2.png)  
**Figure 4.2.2** Mean level of iron in raw and processed forms of kidney bean varieties
4.3 ANTI OXIDANT ANALYSIS

Antioxidant analysis of kidney bean varieties revealed that phenol content in raw RKB, WKB and PB stood at 5.19±1.12, 4.7±0.75 and 14.56±1.0 mg/100g, respectively. On blanching, it was seen that phenol content was decreased significantly in RKB and WKB to 4.12±0.87 and 3.4±1.11 respectively. On the other hand, phenol content in blanched sample of PB was decreased insignificantly to 5.26±1.37mg/100g (Fig: 4.3.1 and 4.3.2)

4.4 ANTI NUTRIENT ANALYSES

Fig: 4.4.1 and 4.4.2 and fig.:4.4.3 and 4.4.4 demonstrates the antinutrient content of three kidney bean varieties. It was found that in raw sample of kidney beans viz. RKB, WKB and PB, tannins content was 4533±251, 2000±200 and 3100±200 mg/100g respectively which was decreased significantly during blanching with a values coming down to 2833±602 and 2766±251 mg/100g for RKB and PB respectively. But in the blanched sample of WKB, it was decreased insignificantly in to 833.3±208 mg/100g. Phytic acid content of raw samples of RKB, WKB and PB was 543±6.1, 483±7.5 and 513±4.0 mg/100g respectively. After processing, the phytic acid content decreased significantly in blanched samples of RKB, WKB and PB to 343±9.7, 356±9.4 and 460±3.6 mg/100g respectively.
Results

Figure 4.4.1 Mean level of tannins and phytic acid in raw form of kidney bean varieties

Total cyanogens content of raw samples kidney beans viz. RKB, WKB and PB was 0.04±0.002, 0.03 ± 0.001 and 0.05±0.001 mg/100g. In blanched samples it was found to be 0.03 ± 0.002, 0.02 ± 0.001 and 0.03±0.001 mg/100g for RKB, WKB and PB respectively. The value of cyanogens content got reduces insignificantly after processing. The trypsin inhibitor activity in raw kidney beans was found as12.2±0.81, 25.0± 1.04 and 23.8±0.82 U/g for RKB, WKB and PB respectively. After the application of household processing i.e. blanching, the trypsin inhibitor activity was decreased significantly in RKB, WKB and PB to 12.0±0.79, 22.2± 0.96 and 20.7±0.92 U/g respectively. It was observed that all the antinutrients analyzed, viz. tannins, phytic acid, total cyanogens and trypsin inhibitor, decreased significantly during household processing treatment- blanching.

Figure 4.4.2 Mean level of tannins and phytic acid in processed form of kidney bean varieties

Figure 4.4.3 Mean level of total cyanogens in raw and processed forms of kidney bean varieties

Figure 4.4.4 Mean level of trypsin inhibitor activity in raw and processed forms of kidney bean varieties
Results

*One unit (U) of the inhibitor activity was expressed as decrease by one unit of absorbance measured at 620nm in 20 min.

4.5 SENSORY EVALUATION

Standard= Food product developed without kidney beans, VAR: A1; VAR: B1; VAR: C1= Food product developed by incorporating raw red kidney beans, raw white kidney beans, raw pinto beans respectively, VAR: A2; VAR: B2, VAR: C2= Food product developed by incorporating blanched red kidney beans, blanched white kidney beans, blanched pinto beans respectively.

4.5.1 PRODUCT DEVELOPMENT

4.5.1.1 Wheat Rajmah premix

Legume flours are quite useful for enriching the cereal and root flours to prepare infant feeds. Six variants of weaning recipe i.e. wheat rajmah premix were developed by incorporation of raw and blanched forms of different varieties of kidney bean flour at 10%. It had good digestibility and acceptability by infants. Acceptability evaluation scores of wheat rajmah premix were shown in Figure 4.5.1.1. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 7.3±0.58 and among all variants, VAR: A1 was most acceptable with an overall acceptability score of 6.9±1.08 and VAR: C1 was least acceptable with an overall acceptability score of 6.3±1.11. There was a no significant difference (P>0.05) between standard and VAR: A1. In terms of appearance and color, standard was best, while among variants, VAR: A2 got higher scores as compared to other variants. In terms of texture, panel members gave preference to standard. While, VAR: A1 was their second choice. Taste wise, standard got first place. VAR: B2 got highest mean score after standard. It was followed by VAR: B1, A1. Likeability of standard was best in terms of after taste. Then, VAR: B1 was more acceptable among all variants. In terms of flavor, standard was liked the most. After standard, VAR: B1 had higher mean acceptability as compared to other variants (Recipe photograph vide 4.5.1.P1).
4.5.1.2 Chivra Rajmah premix

*Chivra rajmah premix* was made for infants as a complementary food. Six variants of weaning recipe i.e. *chivra rajmah premix* were developed by incorporation of raw and blanched forms of different varieties of kidney bean flour at 10%. Acceptability evaluation scores of *chivra rajmah premix* were shown in Figure 4.5.1.2. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 9.0±1.32 and among all variants, VAR: B2 was most acceptable and VAR: C2 was least acceptable with an overall acceptability score of 7.1±1.01 and 6.6±1.11 respectively. There was a significant difference (P<0.05) between standard and VAR: B2. In terms of appearance and color, standard got highest mean scores followed by VAR: A2 and VAR: B2. The texture of standard was most liked by panel members. After standard, VAR: A2 was good in texture and had higher scores among all variants. Taste of VAR: B1 was liked the most after standard. VAR: A2 was next after that. VAR: B1 had highest and VAR: C2 had lowest scores in terms of flavor after standard recipe. In context to flavor also, VAR: B1 was liked most after standard and had good mouth feel in terms of after taste as compared to other variants. (Recipe photograph vide 4.5.1.P2).
Fig./Pic. 4.5.1.2 Acceptability evaluation scores of Chivra rajmah premix

4.5.1.3 Blended boondi

Blended boondi was developed by incorporation of kidney bean flour of different varieties in raw and blanched forms at 50% in six variants. Acceptability evaluation scores of blended boondi were shown in Figure 4.5.1.3. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.0±0.81 and among all variants, VAR:A1 was most acceptable with an overall acceptability score of 7.8±0.62 and VAR:B2 was least acceptable with an overall acceptability score of 7.2±1.0. There was a no significant difference (P>0.05) between standard and VAR: A1. After standard, the appearance of VAR: C1 was most acceptable by panel members. In terms of color, standard was highly acceptable. VAR: A1 got higher mean scores amidst variants. Highest mean scores for texture were observed for standard, VAR: A1 became the second choice of panel members. Standard was best in terms of taste too. This was followed by VAR: C1 and next to VAR: A1. VAR: C1 and A1 had slightly different mean scores. The flavor of VAR: A1 was best and got higher scores after standard. Likeability of standard for after taste was most acceptable. VAR: A1 was next to standard. (Recipe photograph vide 4.5.1.P3).
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4.5.1.4 Rajmah-Rice toffee

Rajmah-Rice toffee was developed by incorporating raw and blanched forms of different varieties of kidney bean flour at 20% in all variants. Acceptability evaluation scores of rajmah-rice toffee were shown in Figure 4.5.1.4. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 7.7±0.77 and among all variants, VAR: B1 was most acceptable and VAR: B2 was least acceptable with an overall acceptability score of 7.5±0.80 and 7.2±0.68 respectively. There was no significant difference (P>0.05) between standard and VAR: B1. Standard got highest mean score in terms of appearance followed by VAR: B2 among all variants. Color wise, standard was best and VAR: C1 was much better as compared to other variants. The texture of VAR: B2 and VAR: C2 were liked the most while standard was the next preference by panel members. Taste wise standard was best and VAR: B2 got higher and VAR: C2 got lowest mean scores. Likeability of standard for flavor was high. Next place was given to VAR: B1. In terms of after taste, standard was first choice of panel members followed by VAR: B1 (Recipe photograph vide 4.5.1.P4).
4.5.1.5 Nutri-sickle

Six variants of *nutri-sickle* were developed by incorporation of kidney bean flour of three varieties in raw and blanched forms at 20%. Acceptability evaluation scores of *nutri-sickle* were shown in Figure 4.6.1.5. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 7.8±0.50 and among all variants, VAR: A2 was most acceptable with an overall acceptability score of 7.5±1.02 and VAR: A1 was least acceptable with an overall acceptability score of 7.2±0.77. There was no significant difference (P>0.05) between standard and VAR: A2. Appearance of standard was liked the most followed by VAR: A2. In terms of color, again standard stood out. VAR: A2 was most acceptable amidst variants after standard. Texture of standard was the most acceptable. VAR:C2 was also highly acceptable after standard. Taste and flavor wise, standard was most acceptable and had highest mean scores and among all the variants, VAR: A2 was highly acceptable. After taste of VAR: A2 had recorded the highest among all variants. But standard was the best among all. (Recipe photograph vide 4.5.1.P5).
### Results

![Acceptability evaluation scores of Nutri-sickle](image)

**4.5.1.5 Acceptability evaluation scores of Nutri-sickle**

**4.5.1.6 Cookies-en-rajmah**

Six variants of *cookies-en-rajmah* were prepared by incorporation of raw and blanched forms of different varieties of kidney bean flour at 15%. Acceptability evaluation scores of *cookies-en-rajmah* were shown in Figure 4.5.1.6. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.7±0.44. VAR: B2 was most acceptable and VAR: A1 was least acceptable with an overall acceptability score of 8.6±0.48 and 7.9±0.77 respectively. There was a no significant difference (P>0.05) between standard and VAR: B2. Appearance of standard was the best. VAR: B2 was next and more acceptable than other variants. In terms of color, standard was most acceptable followed by VAR: A2 amidst variants. Acceptability of standard was highest in terms of texture. VAR: C2 got higher mean scores after standard. Taste and flavor of standard was preferred and next to it, VAR: B2 was preferred by panel members. Panel members found standard as best of all variants in terms of after taste. Then VAR: B2 was placed and got higher mean scores. While, VAR: C1 was least acceptable and had lowest scores. (Recipe photograph vide 4.5.1.P.)
Fig. 4.5.1.6 Acceptability evaluation scores of Cookies-en-rajmah

4.5.1.7 Rom-pom poli

Rom-pom poli was prepared by incorporating raw and blanched forms of different varieties of kidney bean flour at 15% in all variants. Acceptability evaluation scores of rom-pom poli were shown in Figure 4.5.1.7. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 7.8±1.2 and amidst variants, VAR: B1 was most acceptable with an overall acceptability score of 7.4±1.16 and VAR: C2 was least acceptable with an overall acceptability score of 6.7±2.39. There was no significant difference (P>0.05) between standard and VAR: B1. Appearance of standard was found the best. VAR: A1 and VAR: B1 both were equally acceptable appearance wise. Color followed the same pattern. Standard got highest mean scores. VAR: B1 was next to it. In terms of texture, standard stood above all variants. VAR: A1 got first rank after standard. Panel members liked the taste of VAR: B1 after standard. VAR: A1 was the second choice of panel members after standard in terms of flavor and after taste both. (Recipe photograph vide 4.5.1.P7).
Fig./ Pic. 4.5.1.7 Acceptability evaluation scores of Rom-pom poli

4.5.1.8 Nourishing Churma

Nourishing churma was developed from the raw and blanched forms of kidney bean flour of three varieties at 20%. Acceptability evaluation scores of nourishing churma were shown in Figure 4.5.1.8. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.4±0.64 and among all variants, VAR: A1 was most acceptable with an overall acceptability score of 8.0±0.80 and VAR: C2 was least acceptable with an overall acceptability score of 7.6±0.81. There was a no significant difference (P>0.05) between standard and VAR: A1. In terms of appearance, standard ranked the highest among all variants followed by VAR: B2. Color of standard was liked the most and VAR: B1 and VAR: B2 both had same mean scores and took second place. Standard was the first choice of panel members and VAR: A1 was the second choice in terms of texture and taste both. Flavor wise, standard was again the most acceptable sample. This was followed by VAR: B2. VAR: C2 was the least acceptable among all. After taste of standard again took first
rank among all the variants. VAR: B2 was more acceptable in comparison to other variants. (Recipe photograph vide 4.5.1.P).

Fig./ Pic. 4.5.1.8 Acceptability evaluation scores of Nourishing churma

4.5.1.9 Rajmah bati

Six variants of rajmah bati as raw and blanched kidney bean varieties were developed by incorporation of kidney beans flour at 20%. Acceptability evaluation scores of rajmah bati were shown in Figure 4.5.1.9. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 7.8±0.74 and among all variants, VAR: A1 was most acceptable and VAR: C2 was least acceptable with an overall acceptability score of 7.6±0.91 and 7.0±1.25 respectively. There was no significant difference (P>0.05) between standard and VAR: A1. In terms of appearance, standard was most preferable followed by VAR: B1. Color wise, standard was the best followed by VAR: A1 among all variant samples. Texture of standard like other attributes was found the most acceptable. VAR: B2 was placed next to it. Taste of standard was superior and among all variants, VAR: B1 was most acceptable with higher mean scores and VAR: C2 was least acceptable. Standard stood out in terms of flavor too. While, VAR: B2 was next to standard. Standard was having the best
mean scores in terms of after taste. While, VAR: B2 had best scores as compared to other variants. (Recipe photograph vide 4.5.1.P).

**Fig./ Pic. 4.5.1.9 Acceptability evaluation scores of Rajmahbati**

**4.5.1.10 Raj-Rasam**

*Raj-rasam* was developed from the raw and blanched forms of kidney bean varieties in whole form at 15%. Acceptability evaluation scores of *raj-rasam* were shown in Figure 4.5.1.10. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.5±0.61 and among all variants. VAR: C1 was most acceptable and VAR: B2 was least acceptable with an overall acceptability score of 8.4±0.61 and 8.0±0.96 respectively. There was a no significant difference (P>0.05) between standard and VAR: C1. In terms of appearance, standard ranked first followed by VAR: C1. Color wise, standard was liked the most. VAR: A1 and VAR: C1 scored same mean score and stood second after standard. Texture of standard was more preferred as compared to other variants. VAR: C1 was most acceptable and VAR: B2 was least acceptable. Standard took first place in terms of taste. It was followed by VAR: C2. Standard was also found the best in terms of
flavor and after taste. While, VAR: C2 ranked second after standard among all variants. (Recipe photograph vide 4.5.1.P10).

Fig./ Pic. 4.5.1.10 Acceptability evaluation scores of Raj-rasam

4.5.1.11 Bean-bade

Six variants (raw and blanched forms) of bean-bade were developed by incorporation of kidney bean flour at 30%. Acceptability evaluation scores of bean-bade were shown in Figure 4.5.1.11. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.5±0.51 and among all variants, VAR: A1 was most acceptable with an overall acceptability score of 8.2±0.88 and VAR: C1 was least acceptable with an overall acceptability score of 7.9±0.96. There was no significant difference (P>0.05) between standard and VAR: A1. Appearance of standard was also best of all. It was followed by VAR: A1 which had almost similar scores. VAR: C1 was least acceptable. Standard took first place in terms of color too. On the other hand, VAR: B1 got higher mean scores than other variants. In terms of texture, standard was best followed by VAR: A1. Panel members preferred VAR: A2 after standard in terms of taste. Flavor of standard was liked the most among all. After this panel members had given same scores to VAR: A1 and VAR:
A2. In terms of after taste, panel members selected standard as their first choice followed by VAR: A1. VAR: C1 was least acceptable (Recipe photograph vide 4.5.1. P11).

Fig. Pic. 4.5.1.11 Acceptability evaluation scores of Bean-bade

4.5.1.12 Smridh upma

Smridh upma was developed by incorporation of whole kidney beans of three varieties at 30% in all the six variants i.e. raw and blanched forms. Acceptability evaluation scores of smridh upma were shown in Figure 4.5.1.12. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.0±0.5and among all variants, VAR: A1 was most acceptable and VAR: B2 was least acceptable with an overall acceptability score of 7.5±0.70 and 6.6±1.21 respectively. There was a no significant difference (P>0.05) between standard and VAR: A1. Appearance of standard was best and among variants, VAR: C2 was best followed by VAR: A2 and VAR: B1 equally. Color of standard was found to be the most acceptable. It was followed by VAR: C2. In terms of texture, standard was most acceptable. VAR: A2 was most and VAR: B2 was least acceptable by panel members. Taste wise, standard was also best. After standard, VAR: A1 was given high priority and scores among all variants. Standard was found to be the most acceptable in terms of flavor. VAR: C1
Results was more liked as compared to other variants. VAR: B2 was least acceptable among all variants. Panel members selected standard as best in terms of after taste and VAR: A1 as the best of six variant bunch. (Recipe photograph vide 4.5.1.P12).

Fig./Pic. 4.5.1.12 Acceptability evaluation scores of Smridh upma

4.5.1.13 Paustik poha

Six variants of paustik poha were developed by incorporation of different varieties of whole kidney beans in raw and blanched forms at 20%. Acceptability evaluation scores of paustik poha were shown in Figure 4.5.1.13. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 7.8±1.36 and among all variants, VAR: A1 was most acceptable with an overall acceptability score of 7.8±1.06 and VAR: C2 was least acceptable with an overall acceptability score of 7.0±1.46. There was no significant difference (P>0.05) between standard and VAR: A1. VAR: B1 stood out first in terms of appearance after standard. Color wise, standard was found the most acceptable among all followed by VAR: A1. Same scenario was found in context to texture and taste. The flavor of standard was best. VAR: A1 was liked most and showed higher mean scores by panel members. Again VAR: A1 was found
to be most acceptable and had good mouth feel after standard. VAR: C2 was least acceptable in terms of after taste. (Recipe photograph vide 4.5.1.P13).

**Fig./ Pic. 4.5.1.13 Acceptability evaluation scores of Paustik poha**

### 4.5.1.14 Augmented-poppadoms

Six variants (raw and blanched forms) of augmented-poppadoms were developed by incorporation of different varieties of kidney bean flour at 10%. Acceptability evaluation scores of augmented-poppadoms were shown in Figure 4.5.1.14. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.1±0.61 and among all variants, VAR: A1 was most acceptable and VAR: B2 was least acceptable with an overall acceptability score of 8.0±0.59 and 7.6±0.61 respectively. There was a no significant difference (P>0.05) between standard and VAR: A1. Standard ranked highest in terms of appearance while VAR: A1 was placed next to it. Standard got higher mean scores than variant A1 in terms of color too. Talking about texture, standard stood out in this case too followed by VAR: A2. Taste wise, standard was best among all variants and next to it, VAR: A1 was
preferred by panel members. Again VAR: A1 was best and got higher scores among all variants after standard in terms of flavor and after taste both. (Recipe photograph vide 4.5.1.P14).

![Acceptability evaluation scores of Augmented-poppadoms](image)

**Fig. Pic. 4.5.1.14 Acceptability evaluation scores of Augmented-poppadoms**

### 4.5.1.15 Rustic papdi

Six variants of *rustic papdi* were developed by incorporation of raw and blanched forms of different varieties of kidney bean flour at 10%. Acceptability evaluation scores of *rustic papdi* were shown in Figure 4.5.1.15. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.6±0.48 and among all variants, VAR: C1 was most acceptable with an overall acceptability score of 8.4±0.72 and VAR: A1 was least acceptable with an overall acceptability score of 8.0±0.84. There was a no significant difference (P>0.05) between standard and VAR: C1. In terms of appearance, standard and VAR: C1 both were equally accepted and had similar scores. Standard stood out among all. VAR: C1 was again best in terms of color. In terms of texture, standard ranked first. Next to it, VAR: C2 ranked second as compared to other variants. Taste wise, standard stood out again and among variants VAR: C1 and VAR: C2 both had higher and same mean scores like standard. In
terms of flavor and after taste, VAR: C1 was most preferred by panel members but standard was still best among all. (Recipe photograph vide 4.5.1.P15).

**Fig./Pic. 4.5.1.15 Acceptability evaluation scores of Rustic-papdi**

### 4.5.1.16 Enriched sev

Six variants of enriched sev as raw and blanched kidney bean varieties incorporated forms were developed by incorporation kidney bean flour at 50%. Acceptability evaluation scores of enriched sev were shown in Figure 4.5.1.16. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.4±0.50 and among all variants, VAR: B1 was most acceptable and VAR: C1 was least acceptable with an overall acceptability score of 7.9±0.77 and 7.4±0.80 respectively. There was a significant difference (P<0.05) between standard and VAR: B1. Mean scores of standard for appearance and color both was found best among all followed by VAR: B1 as compared to other variants. Texture wise, standard was best. Next place was given to VAR: B1. Mean scores of standard for taste was found the most acceptable among all. It was followed by VAR: B1. Standard was observed as the
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best in terms of flavor and after taste. Again VAR: B1 got higher mean scores and had good mouth feel compared to other variants. (Recipe photograph vide 4.5.1.P16).

4.5.1.16 Acceptability evaluation scores of Enriched sev

4.5.1.17 Mix. Veg.-bean khichdi

Six variants of mix.veg-bean khichdi as raw and blanched kidney bean varieties were developed by incorporation kidney bean flour at 10%. Acceptability evaluation scores of mix.veg-bean khichdi were show in Figure 4.5.1.17. From the scores of standard and all variants for each attributes it was clear that standard was most acceptable with an overall acceptability score of 8.0±0.68 and among all variants, VAR:C1 was most acceptable and VAR:B1 was least acceptable with an overall acceptability score of 7.4±0.88 and 7.1±0.80 respectively. There was a non significant difference (P>0.05) between standard and VAR: C1. Appearance of standard was best. It was followed by VAR: C. In terms of color, standard was highly acceptable. VAR: A2 got higher scores among all variants. Highest mean score for texture was observed for standard. VAR: A2 became the second choice of panel members. Standard was best in terms of taste and flavor both. This was
followed by VAR: C1. Likeability of standard for after taste was most acceptable. VAR: B2 was very good and placed next to standard. (Recipe photograph vide 4.5.1.P17).

Fig./ Pic. 4.5.1.17 Acceptability evaluation scores of Mix. veg-bean khichdi

4.5.1.18 **Rissi Missi Roti**

*Rissi missi roti* was prepared by incorporating raw and blanched forms of different varieties of kidney bean flour at 10% in all six variants. Acceptability evaluation scores of *rissi missi roti* were shown in Figure 4.5.1.18. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.1±0.64 and among all variants, VAR: A2 was most acceptable with an overall acceptability score of 7.6±0.81 and VAR:C1 was least acceptable with an overall acceptability score of 7.1±1.18. There was no significant difference (P>0.05) between standard and VAR: A2. Standard got the highest mean score in terms of appearance followed by VAR: C2. Color followed the same pattern. Standard was liked the most followed by VAR: A1. Panel members liked standard the most in terms of texture and taste both. After standard, VAR: B1 had higher acceptability as compared to other variants. Like other attributes, standard got highest mean score among all. VAR: A1
was liked much more in comparison to other variants in terms of flavor. In context of after taste, Standard was liked the most among all. VAR: B1 was most preferred by panel members and had good mouth feel. (Recipe photograph vide 4.5.1.P18).

**Fig./ Pic. 4.5.1.18 Acceptability evaluation scores of Rissi-missiroti**

### 4.5.1.19 Double do Sag

*Double do Sag* was prepared by incorporating raw and blanched forms of different varieties of kidney bean flour at 10% in all six variants. Acceptability evaluation scores of *Double do Sag* were shown in Figure 4.5.1.19. From the scores of standard recipe and its variants for each attribute, it was clear that standard was most acceptable with an overall acceptability score of 8.1±0.99 and among all variants, VAR: C1 was most acceptable and VAR: A1 was least acceptable with an overall acceptability score of 8.1±0.56 and 7.4±0.83 respectively. There was no significant difference (P>0.05) between standard and VAR: B1. Appearance wise, standard stood out first and followed by VAR: B2. Color of standard was best and VAR: C2 got higher mean scores among variants. In terms of texture, standard and VAR: C1 stood out first among all. Taste wise, standard got first place. While, VAR: B2 was their second choice. The color of VAR: A1 was very good after standard among all the variants. Likeability of standard was best in terms of flavor too. VAR: C1 was best in taste and got higher scores among all variants. Mean score
of after taste for standard was found high among all. VAR: C2 had much better mouth feel than other variants and also preferred by panel members. (Recipe photograph vide 4.5.1.P19).

![Fig./ Pic. 4.5.1.19 Acceptability evaluation scores of Double-do sag](image)

### 4.5.2 Rating scores of standard and variants

For each recipe, the variant that got the highest mean acceptability score was given 1 and the one getting lowest score was given 4 in numerical order. After giving marks in above mentioned manner, sum of all scores for each variant was calculated and the same has been appended in figure. Fig. 4.5.2.1 depicts that among six variants and standard the least rating score was scored by standard i.e. 24. It means standard was most acceptable in all. While, among all six variants of recipes, the most acceptable VAR: (A1, B1, C1) incorporated with raw kidney bean flour of three varieties with a rating score of 44 and second most acceptable variant was VAR: (A2, B2, C2) incorporated with blanched kidney bean flour of three varieties with a rating score of 59. Altogether, standard was found to be most acceptable and VAR: (A2, B2, C2) were least acceptable incorporated with blanched kidney bean flour of three varieties.
4.5.3 Overall evaluations of recipes

Overall acceptability evaluations of recipes were shown in Fig. 4.5.3.1. Average of mean values of each attribute (appearance, color, texture, taste, flavor, after taste and over-all acceptability) was calculated for most acceptable variant of each recipe and these values for each recipes are plotted as bars for appraisal at a glance. It was predicted from graph that most acceptable recipe was cookies-en-rajmah with a score of 8.5 and the least acceptable chivra rajmah premix with a score of 6.7. Recipes having overall score above 8.0 were cookies-en-rajmah (8.5), rustic papdi (8.4), bean-bade (8.3), raj-rasam (8.2) and augmented-poppadoms (8.0). On the other hand, overall acceptability score between 7.5-7.9 were scored by seven recipes i.e. nourishing churma (7.9), enriched sev (7.9), paustik poha (7.8), nutri-sickle (7.7), blended boodi (7.7), double do sag (7.6), rajmah-bati (7.5). While remaining recipes viz. wheat rajmah premix (6.9), chivra rajmah premix (6.7), rajmah-rice toffee (7.4), rom-pom poli (7.3), smridh upma (7.3), mix. veg.-bean khichdi (7.4), rissi missi roti (7.4) had scored above 6.5 and below 7.5.