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Development of jack fruit based ready-to - cook (RTC) instant "avail" Mix

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Abstract
The study entitled "Development of jack fruit based ready to Cook (RTC) instant "avial" mix was conducted in the Department of Home Science, College of Agriculture, Vellayani during the period of 2012-2014 with the objective of to develop a value added product from raw jackfruit and to evaluate its quality parameters.
The Koozha type was selected because of its less popularity compared to *Varikka*. "Avial" being a popular raw jack fruit based dish of Kerala, was identified for standardization.
The preliminary processing methods were standardised with respect to size of the jack fruit slices, blanching and immersion in various pre-treatment media in different time durations. The adjuncts in the mixes in various proportions were formulated and dehydrated at 65°C till crisp. These formulations were cooked and evaluated for sensory quality. The identified mix comprised of jack fruit bulbs and seeds, green chilly garlic, cumin, turmeric powder and curry leaves Analysis of sensory parameters namely, appearance, texture, taste, flavour and overall acceptability revealed excellent results. Cooking methods were optimized with respect to reconstitution time, cooking procedures, cooking time and additional ingredients to be added while cooking. Thirty minutes of reconstitution time was found to be the best of all treatments and cooking time of 15 minutes was found to be optimum. Thirty grams of coconut and 3.5 ml of coconut oil was was chosen as the optimum levels of inclusion. Thus a convenient and acceptable product which gave vale addition to jackfruit was standardised. Such products if popularised could overcome the cumbersome handling procedures of jackfruit and make it more popular among the urban classes.

Keywords: Ready to cook mix, Standardisation, Koozha, preliminary processing, sensory quality, adjuncts

Introduction
In Kerala, though jackfruit is not cultivated intentionally, it grows widely in many parts of the state and it is common knowledge that a significant portion of the production goes waste due to many reasons. Invariably the production season coincides with monsoon, making the fruits unacceptable in taste. Besides, difficulties in harvesting, extracting the edible ripe fruit making the hand sticky, attraction of flies are some of the main reasons constraining its wide scale use. Besides jackfruit is perishable and cannot be stored for a long time because of its inherent compositional and textural characteristics. Every year, a considerable amount of jackfruit, specially obtained in the glut season (June-July) goes waste due to lack of proper postharvest knowledge during the stage of harvesting, transporting and storing, which affects both the quality and quantity. Proper postharvest technology for prolonging shelf life has therefore become necessary. Besides, alternate ways of using jackfruits in season can reduce postharvest losses. Here- in, processing techniques have a major role. It adds diversified and attractive food items in daily meals, as well as contributes to the generation of income and employment, when commercially processed.
Though a variety of products have been made from jackfruit, its consumption has decreased over the years. This is mainly due to its cumbersome handling procedures, which is making it unpopular even in rural areas. In this context, developing a convenient ready to cook (RTC) product with this ethnic fruit maintaining all its sensory qualities would be of tremendous value for urban as well as rural housewives. Moreover, for the Malayalees staying away from Kerala in particular, jackfruit means nostalgia. Therefore, there is ample scope for marketing such a RTC jack fruit based product to these migrated population. Such an effort would cater

to the needs of such Malayalees and also to the larger population who crave for variety. Therefore, this study envisages to develop a value added product from raw jackfruit and evaluate its quality parameters.

2. Materials and methods

The methodology of the present study entitled " Development of jackfruit based Ready To Cook (RTC) instant "avial" mix", is presented under the following heads:-

- Selection and collection of jackfruit
- Standardization and product development

Selection and Collection of Jackfruit

Jackfruit koozha type was selected for the study. Raw mature jackfruits were harvested from trees grown in the Instructional farm based on external visible maturity indices such as distance between spines, number of spines per unit area, colour of spines and the number of days elapsed from fruit set (95-110 days).

Standardization and Product Development

"Avial" being a characteristic traditional dish of kerala that needs elaborate preparations, was identified for standardisation, presuming its demand in urban populations

A standardized recipe is one that has been tried, adopted and retried several times for use by a given food service and which has been found to produce the same acceptable results and yield, each time when the exact procedures are used with the same type of equipment and the same quantity and quality of ingredients (USDA, 2001) [16]. Standardization of recipes is an essential strive for high quality products. According to Tolute (2000) [14], the procedure for recipe standardization begins with the process of recipe modification or adjustment.

Preliminary Processing of Jackfruit Bulbs and Seeds

Freshly harvested jackfruits were washed under clean water and cut into large slices. The bulbs and seeds were separated. The fresh weight of bulbs and seeds were recorded in order to determine the final yield of the processed product after dehydration.

Standardization of Width of Slices

Selection of appropriate width of slices of the vegetables to be dried is very important, as thicker slices will dry at a slower rate or may not dry fully and it may subsequently deteriorate after packing than thinner pieces. But in the case of very thin pieces there is a tendency to stick to the drying trays and will also be difficult to remove. So the size and thickness of the jackfruit slices and seeds were standardized. The best of these variations were identified by evaluating the Overall visual quality (OVQ) using a 1-9 point scale where, 9 refers to excellent and fresh appearance, 7 to good, 5 to fair (limit of marketability), 3 to fair useable but not saleable and 1 to unusable (Yuan *et al.,* 2010) [17], by a panel comprising of 10 members. The variations in width of jackfruit bulb and seed slices that were evaluated.

Standardization of Blanching Time

Blanching is a unit operation prior to freezing, canning or drying in which fruits or vegetables are heated for the purpose of inactivating enzymes; modifying texture; preserving color, flavor, and nutritional value; and removing trapped air. Hot water is used as heating media for blanching in industry (Corcuera *et al.,* 2004) [1].

The best identified width of jackfruit bulbs and seeds was subjected to blanching. The optimum blanching time was thus identified by analyzing the scores of OVQ as rated by the sensory panel after blanching. The different periods of time ranged from 3-15 mts

Standardization of Pre-Treatment Media

Pretreating fruits and vegetables for storage is an important step in preserving the produce. It retains the natural colour of the food produce and inactivates enzymes that can cause food spoilage. Torreggiani (1993) [15] reported that pretreatment with chemicals (SO_2), or blanching prior to drying of fruits and vegetables effected the prevention of discolouration. The pre-treatment media giving the best product with respect to appearance and colour was identified.

Hundred grams of blanched slices were immersed in one litre water with the respective additives. The best of these variations were again identified by analyzing the scores of OVQ, as rated by the sensory panel.

Standardization of Immersion Time

Immersion of various vegetables in alkaline or acid solutions prior to drying affected the prevention of discolouration (Sunkja and Raghavan, 2004) [13].

The blanched bulbs and seeds were immersed in the selected mediafrom 10-60 mts. Most suitable immersion time in the selected media for retaining maximum sensory qualities was identified on the basis of scores obtained on hedonic scale for OVQ.

Formulation of Ready to Cook (RTC) Avial Mix from Jackfruit

The adjuncts in *Avial* namely jackfruit bulbs, seeds, green chilly, crushed red chilly, red chilly powder, pepper, garlic, turmeric, cumin and curry leaves were mixed in different combinations and proportions All the formulations were dehydrated at 65°C till crisp. These dehydrated formulations were cooked and subjected to organoleptic evaluation.

Organoleptic evaluation or sensory analysis is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses *viz*., sight, smell, taste, touch and hearing for the purpose of evaluating consumer products (IFT, 2005) [3].

Standardization of Cooking Methods

Dehydrated products are in an acceptable stage for cooking, only if they are reconstituted with water. Besides the details of reconstitution is essential to be conveyed to the consumer. Here the reconstitution time and media were standardized.

Optimization of Reconstitution Time of RTC Products

The dehydrated *Avial* mix was reconstituted in different time durations. For this the formulated ready to cook mix was soaked in cold water from 10-45 mts and evaluated for sensory qualities after cooking till done.

Optimization of Cooking Procedures and Cooking Time

For optimizing cooking procedures proportion of RTC mix and water were in the ratio of 1:5. Water was strained out from the reconstituted mixes and subjected to different cooking methods. Cooking time was also evaluated for the mix by the members of the panel.

Grated coconut and coconut oil are essential ingredients in Kerala dishes. Since they are perishable ingredients they were not included in the RTC mix. Instead grated coconut and oil were added into *Avial mix* in different proportions while cooking

The different treatments were evaluated by the sensory panel and the scores were analysed to identify the best treatment. The products were packed in PET and laminated pouches for further studies.

The standardized preparation of jackfruit RTC avial mix developed is presented in the following flow diagram (Figure 1).

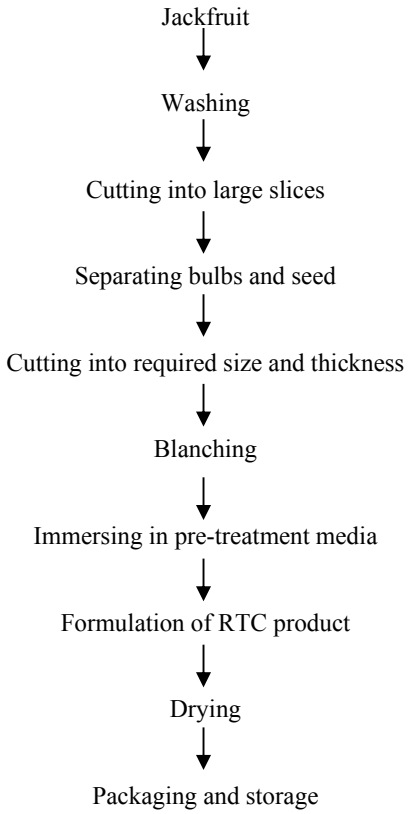

Fig 1: Flow diagram for preparation of RTC product

3. Results and Discussion

Standardization of Width of Slices

Width of slices were varied keeping in mind that water loss increases with increase in the surface area of fruit pieces. It is important that all of the pieces are about the same size, so that they would dry at the same rate (James and Kuipers, 2003) [4].

The mean values of scores allotted by the panel members for overall visual quality was worked out. Overall visual quality (OVQ) scores revealed that T_3 with 1.5cm scored the highest value (8.35) for the preparation of *Avial* mix. The values were found to be significantly different as revealed by the CD value (Table 1).

Table 1: OVQ scores of jack fruit slices width

Treatments	OVQ scores
T1(0.5cm)	6.15
T2(1.0cm)	7.00
T3(1.50cm)	8.35
T4(2.0cm)	6.30
CD(0.05)-0.40 SE-+/-0.14	

Standardization of Blanching Time

Table 2 indicates OVQ scores of blanched jackfruit slices prior to drying. Blanching helps to slow or stop the enzyme activity that can cause undesirable changes in flavour and texture during storage. It expands the tissues, so the slices dry faster. Moreover it helps protect vitamins and retain colour and also reduces the time needed to refresh vegetables before cooking (Kendall *et al*., 2005). The scores of OVQ of jackfruit slices were analysed with various time durations *viz*., 3min, 5min, 7min, 10min and 15min in blanching.

The highest score was obtained for T_1 (8.45) being 3min. This was followed by T_2 and T_3 (5 and 7 min respectively). This difference in values in treatments were found to be statistically significant too.

Table 2: OVQ scores of blanched raw material

Treatments	*OVQ Scores*
T1(3mts)	8.45
T2(5mts)	7.35
T3(7mts)	6.40
T4(10mts)	6.05
T5(15mts)	5.50
CD(0.05)-0.37 SE-+/-0.13	

Standardization of Pre-Treatment Media

In order to prevent browning and to preserve colour of the dehydrated mixes different pre- treatment media comprising of salt (0.5%), KMS (0.2%), ascorbic acid (0.1%), citric acid (0.2%) and their combinations were used.

On analysing the OVQ scores, the treatment T_5 with salt (0.5%) and KMS (0.2%) was observed to have the highest scores: 8.45 for *Avial mix*, followed by T_2 with KMS (0.2%). The treatment T_6 (salt 0.5 and Ascorbic acid 0.1%) and T_{10} (ascorbic acid and citric acid) showed the lowest scores. Hence T_5 was selected from among the 12 treatments as best pre-treatment media for jackfruit slices (Table 3).

Table 3: OVQ scores of pre-treated jackfruit slices

Treatments	*Avial* Mix
T_1 (Salt (0.5%))	6.10
T_2 (KMS (0.2%))	8.10
T_3 (Ascorbic acid (0.1%))	1.70
T_4 (Citric acid (0.2%))	6.35
T_5 (Salt (0.5%) + KMS (0.2%))	8.45
T_6 (Salt (0.5%) + Ascorbic acid (0.1%))	1.60
T_7 (Salt (0.5%) + Citric acid (0.2%))	6.45
T_8 (KMS (0.2%) + Ascorbic acid (0.1%))	3.20
T_9 (KMS (0.2%) + Citric acid (0.2%))	7.20
T_{10} (Ascorbic acid (0.1%) + Citric acid (0.2%))	1.60
T_{11} (KMS (0.2%) + Ascorbic acid (0.1%) + Citric acid (0.2%))	1.65
T_{12} (KMS (0.2%) + Ascorbic acid (0.1%) + Citric acid (0.2%) + Salt (0.5%))	1.7

Standardisation of Immersion Time

The immersion time of jackfruit slices in pre-treated media were set in different time durations such as 10min, 15min, 20min, 30min, 45min and 60min.

Table 4: OVQ scores of jack fruit slices pre-treated in different timings

Treatments	*Avial* Mix
T_1 (10 min)	5.60
T_2 (15 min)	6.20
T_3 (20 min)	6.45
T_4 (30 min)	8.40
T_5 (45 min)	7.15
T_6 (60 min)	7.10
CD-(0.05)-0.13 SE-+/-0.36	

Treatment T_4 (30min) gave the highest scores for OVQ "avial" mix (8.40.) While T_1 (10min) gave the lowest scores. The value of T_4 was significantly higher than the other treatments.

Formulations the of Ready to Cook (RTC) mix

Ready to Cook products are primarily targeted for persons with busy life style, convenience seekers and mobile women. The newly emerging era of fast foods, convenience foods and instant foods are becoming increasingly popular among Indian households (Rajpur, 2007) [9]. According to Solanki (2000) [11] there is an urgent need to develop low cost ready to cook mix to improve the nutritional status of our population along with saving time.

In the present study, different combinations of dehydrated RTC products were formulated keeping the jackfruit bulb and seeds as the major ingredients and varying the amounts and proportion of adjuncts used. A sensory panel evaluated the various formulations with respect to the five parameters namely, appearance, colour, texture, flavour, taste and overall acceptability.

According to FAO (2003) [2], sensory evaluation is a common and very useful tool in quality assessment of processed products. It makes use of the senses to evaluate the general acceptability and quality attributes of the products, which is what finally leads to demand of a product.

When food is assessed by human sensory organs, the evaluation is said to be sensory analysis (Simi, 2002) [10]. Sensory evaluation is defined as "A scientific discipline used to evoke, measure, analyze, and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste, and hearing" (Stonel and Sidel, 1993). Although sensory evaluation of food is the most important for quality assessment, taste evaluations are not practical for routine quality control. But to have quantitative methods too, rejection points are established by sensory means (Jonnalagadda *et al.,* 2001) [5]. The discipline requires panels of human assessors, on whom the products are tested, followed by recording the responses made by them. Numerical scoring is used to evaluate particular characteristics of one or more samples indicating the rating as excellent, very good, fair and poor (Manay and Swamy, 2000) [7].

Five combinations were formulated for *Avial* mix. The organoleptic evaluation of formulated RTC *Avial* mix was done by panel of 10 judges and the data is presented in the Table 18.

Appearance

The first impression of food depends on its appearance. The mean rank values for appearance of the five formulations of *Avial* ranged from 12.15-45.50. The highest mean rank value (45.50) for appearance was observed in AP_3 which was a combination of jackfruit bulbs and seeds, red chilly powder, garlic, jeera/cumin, turmeric powder and curry leaves. Analysis of scores revealed that the formulation AP_3 was significantly superior in appearance than the other formulations.

Colour

Colour is one of the important visual attributes that has been used to judge the overall quality of foods for a very long time. Among the formulations AP_3 was noted to get the highest mean rank value (45.50) while AP_5 recorded the least mean rank value (13.50) for this parameter. There was significant difference in these scores of the formulations.

Texture

Texture constitutes physical property of a food stuff as apprehended by the eye, skin and muscle senses located in the mouth. The highest mean rank value (45.50) in texture was obtained for the formulation AP_3. The formulations AP_5 with constituents pepper, garlic, jeera, turmeric powder and curry leaves got the least mean rank value (12.55) among the treatments.

Flavour

Odour preference is generated by stimulation of sensory cells by specific volatile compounds present in foods. The flavour of different formulated *Avial* mixes differed in mean rank values, which ranged from 13.75-45.15. The highest mean rank value was recorded by AP_3 (45.15) and least value was scored by AP_5 (13.75). This differences were statistically significant too.

Taste

Taste is the major attribute which determines the acceptability of a food. Taste is the sensation produced when a substance in the mouth reacts chemically with receptors of taste buds. Superior taste was found in AP_3 with the highest score of 45.20 and least was noted in AP_5 (11.25) the difference in these scores were also found to be significant.

Overall Acceptability

Overall acceptability also clearly depicted that among the 5 formulations AP_3 obtained maximum mean rank value (45.50) and highest preference in overall acceptability. Least mean rank value (19.70) and less preference was recorded for AP_5. The kruskal values indicated that there was significant difference in the scores obtained for the parameters of five formulations for AP_5. and AP_3. On the basis of this AP_3 was selected as best combination.

Table 5: Sensory quality of various formulations of *Avial* mix

Formulations	Mean rank values					
	Appearance	**Colour**	**Texture**	**Flavour**	**Taste**	**Overall acceptability**
AP_1	25.95	22.30	25.80	20.95	18.60	18.60
AP_2	24.50	23.90	26.20	26.70	23.25	22.40
AP_3	45.50	45.50	45.50	45.15	45.20	45.50
AP_4	19.40	22.30	17.45	20.95	29.20	21.30
AP_5	12.15	13.50	12.55	13.75	11.25	19.70
χ^2	30.78	28.69	31.47	28.58	33.37	25.85
CV	12.77					

Avail mix

Plate 1: Finalized RTC mix

The identified treatments namely, AP_3, was dehydrated till crisp at 65 °C. After cooling they were packed in airtight containers.

Standardization of Cooking Methods of the Ready to Cook Mix

The cooking methods to be adopted by the customer were standardized. The reconstitution time and methods were standardized systematically.

Optimization of Reconstitution Time

Drying is one of the oldest and most widely used methods of food preservation, however, its success largely depends on the rehydration quality (reconstitution) of dried products. The dried products will be acceptable as a food only if the color, texture, flavor, taste and nutritive value are retained to the maximum when they are reconstituted with water. If pre-drying treatment and drying itself would not induce any changes in the material, rehydration could be treated as a reversible process of dehydration. In practice most of the changes are irreversible and rehydration cannot be considered simply as a process reversible to dehydration (Krokida and Marinos, 2003) [6]. Rehydration can be considered as a remedy to the injury in the material caused by drying and treatments preceding dehydration (Minn and Magee, 2003) [8].

The formulated RTC mix was reconstituted by various treatments. Initially the measured quantity of mixes were soaked in plain water for 10min, 15min, 20min, 30min and 45min.

Table 6 presents the data of evaluation of reconstitution time of formulated mix.

Optimization of Reconstitution Time of RTC Avial Mix

The dried product was immersed in various time durations in cold water. The reconstitution time was evaluated with respect to sensory parameters of the products *viz*., appearance, colour, texture, flavour, taste and overall acceptability.

Appearance

When the scores for appearance were analysed, treatment R_4 (30 min) was found to be give the highest mean rank value (45.30) and R_1 (10 min) got lowest score (7.80). The difference among the scores was found to be significant. It ranged from 7.80-45.30.

Colour

The mean rank values for colour ranged from 8.10-45.50. The highest mean rank value (45.50) for the parameter colour was obtained for the treatment R_4. Mean rank value of R_5 (45min) was 32.95 and R_1 (10min) scored the lowest mean rank value (8.10).

The statistical analysis of the observations related to texture revealed that, treatment R_4 got highest mean rank value (45.10) and lowest mean rank value (7.80) was observed for R_1. There was significant difference in these scores obtained for this parameter.

Flavour

Kruskal values revealed that, the maximum mean rank value (45.30) for flavour was noted in the treatment R_4 while minimum mean rank value was scored by R_1. The statistical analysis of data depicted that the difference was significant.

Taste

The scores ranged from 8.70-45.10. The highest mean rank value (45.10) for taste was secured for the treatment R_4. R_5 (45 min) scored the mean rank value of (34.20) and R_1 (10 min) obtained lowest mean rank value (8.70). There was significant difference among R_1, R_3, R_4 and R_5.

Overall Acceptability

When the kruskal values for overall acceptability scores were analysed, it revealed that R_4 (30 min) was found to be superior with the highest mean rank value (45.10), followed by R_5 (45min) with the mean rank value of 33.80 and R_1 scored the least value (9.00).

As inferred from the Kruskal values depicted in Table 21. It can be concluded that, R_4 (30min) was found to be superior in all the sensory parameters. So R_4 (30min) was selected as the best reconstitution time of the formulated *Avial* Mix.

Table 6: Sensory quality of RTC *Avial* mix with varying reconstitution time

Formulations	Mean rank values					
	Appearance	**Colour**	**Texture**	**Flavour**	**Taste**	**Overall acceptability**
R_1 (10 min)	7.80	8.10	7.80	8.75	8.70	9.00
R_2 (15 min)	16.40	16.45	16.85	16.25	17.35	16.85
R_3 (20 min)	23.30	24.50	24.15	23.60	22.15	22.75
R_4 (30 min)	45.30	45.50	45.10	45.30	45.10	45.10
R_5 (45 min)	34.70	32.95	33.60	33.60	34.20	33.80
χ^2	42.15	40.62	40.36	39.87	39.61	39.01
CV	12.77					

Optimization of Cooking Procedures and Cooking Time

Cooking Procedures

Directions regarding using a packed commodity is needed at the consumer level. This adds to the acceptance of the products. Optimization of cooking procedures of the dehydrated mix was conducted after various treatments. Treatments were again evaluated on the basis of organoleptic evaluation by a panel of 10 members.

Tables 8 presents the evaluation of the cooking procedures *viz*., cooking in plain hot water (CP_1), cooking in strained (strained water is the excess water after rehydration of the products) hot water (CP_2), cooking in plain cold water(CP_3), and cooking in strained cold water (CP_4).

Appearance

When the kruskal values for appearance was analysed. CP_2 (cooking in hot strained water) obtained significantly higher mean rank value (35.20) as compared to other formulations and CP_3 ie, cooking in plain cold water got the least mean rank value.

Colour

The maximum mean rank value was noted for CP_2 (35.15), while CP_3 scored the least mean rank value (8.39) for this parameter. There was significant difference in these scores for this cooking procedure.

Texture

Analysis of scores revealed that CP_2 ranked first with the mean rank value of 35.25 and CP_3 got the least mean rank value (12.80) among the treatments. The difference in these scores were also significant.

Flavour

The scores for flavour varied greatly. It is ranged from11.25-35.35. CP_2 scored the highest mean rank value (35.35) and CP_3 got least value 11.25.

Table 8: Sensory Quality of RTC *Avial* mix with variations in cooking procedure

Formulations	Mean rank values					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
CP_1	18.95	19.20	16.45	19.35	15.70	16.35
CP_2	35.20	35.15	35.25	35.35	34.90	35.50
CP_3	6.25	8.39	12.80	11.25	13.05	14.50
CP_4	21.60	19.25	17.50	16.05	18.35	15.65
χ^2	31.80	27.67	23.28	25.67	22.37	23.12
CV	10.24					

CP_1 = Cooking in plain hot water CP_2 = Cooking in strained hot water

CP_3 = Cooking in plain cold water CP_4 = Cooking in strained cold water

Taste

The difference in the scores obtained for this attribute was found to be significant. Maximum mean rank value was noticed for CP_2 (34.90), followed by CP_4 (cooking in strained cold water) with a mean rank value of 18.35 and least mean rank value was obtained for CP_3 (13.05).

Overall Acceptability

Among the four cooking procedures CP_2 obtained maximum mean rank value (35.50) for overall acceptability. The scores ranged between 14.50-35.50. The kruskal values indicates that there was significant difference in the scores obtained for the parameters.

On the basis of scores of sensory evaluation, CP_2 (cooking in strained hot water) was selected as best cooking method.

Optimization of Cooking Time of Dehydrated RTC Mixes

Optimization of cooking time of dehydrated mixes is also important at the consumer level. It was evaluated on the basis of organoleptic evaluation judged by 10 panel members.

Table 9 reveals the kruskal values of the RTC mixes cooked in different time durations 6min, 8min, 10min and 15min.

The variations in duration of cooking time of the *Avial* mix was evaluated (6 min-15 min). The organoleptic evaluation was conducted in the formulated RTC *Avial* mixes by a panel of 10 judges to find out the optimum cooking time. The results of sensory evaluation are presented in the Table 9

Appearance

The mean rank values for appearance ranged from 6.20-35.30. C_4 (15min cooking time) was found to be give the highest mean rank value (35.30) and C_1 (6min cooking time) got lowest mean rank value (6.20). These score were found to be significantly different.

Colour

The mean rank values obtained for the colour parameter ranged from 6.80-35.50. The obtained scores were significantly different. Statistical analysis depicted that treatment C_4 received maximum mean rank value (35.50), C_3 was placed second with a mean rank value of 25.25 which was on par with C_2 and C_1 scored the least mean rank value (6.80).

Texture

It is noticed from the Table 27 that there was significant difference in the extreme mean rank values obtained for texture which ranged from 6.80-35.50. C_4 got the highest mean rank value (35.50) and C_1 obtained the least mean rank value (6.80).

Flavour

It was observed that, maximum mean rank value (35.50) was secured by the treatment C_4, which was on par with C_3 (10min cooking time) with a mean rank value of 25.90 and C_1 obtained a minimum mean rank value of 6.65. The statistical analysis of data depicted that the scores were significantly different.

Taste

Table 27 further shows that the mean rank value obtained for taste ranged from 6.70-35.50. It was observed that C_4 (15min-cooking time) got the highest mean rank value (35.50), followed by C_3 (10 min-cooking time) with the mean rank value of 25.90 and C_1 (6min-cooking time) received the least mean rank value (6.70).

Overall Acceptability

As per the results depicted in the Table 9, the obtained mean rank values ranged from 6.00-35.50. C_4 with 15 min cooking time of *Avial* mix obtained the highest mean rank value (35.50), followed by C_3 with the mean rank value (23.10) and

C_1 scored the least mean rank value (6.00).

Table 9 represents the various parameters such as appearance, colour, texture, flavour, taste and overall acceptability which were assessed separately to find out the best treatment in varying time duration. The statistical data presented that C_4 (15min-cooking time) secured the highest mean rank value for all the sensory parameters. It indicates that C_4 (15min) was the best treatment to satisfy all the organoleptic qualities during cooking of *Avial* mix. So C_4 (15min-cooking time) has selected as best for further study.

Table 9: Sensory quality of RTC *Avail* mix with varying cooking time

Formulations	Mean rank values					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
C_1 (6 min)	6.20	6.80	6.80	6.65	6.70	6.00
C_2 (8 min)	16.05	15.45	15.60	15.95	15.90	17.40
C_3 (10 min)	24.45	25.25	25.10	25.90	25.90	23.10
C_4 (15 min)	35.30	35.50	35.50	35.50	35.50	35.50
χ^2	34.40	34.38	34.35	34.32	34.33	34.01
CV	10.24					

Optimization of Additional Ingredients to be added

To give useful hints to the consumers as to the additional perishable ingredients to be added before serving, the amount of coconut to be added was standardized.

Coconut is an indispensable ingredient in these traditional recipes. The amount of coconut, to be added, was standardised after trials in different levels. The amount ranged from 10-50g per 50g of dry RTC mixes.

Coconut forms one of the major ingredients in *Avial*. In order to assess the optimum amount of coconut, five variations were tried and evaluated by a sensory panel.

Appearance

The variations in the amount of coconut added into the *Avial* mix was evaluated. The obtained mean rank values ranged from 5.95-43.10. C_3 (30g) was found to be give the highest mean rank value (43.10) and C_1 (10g) got the least mean rank value (5.95). The difference among these scores were found to be significant.

Colour

The mean rank values obtained for the colour ranged from 5.65-44.20. The statistical analysis revealed that treatment C_3 (30g of coconut) received the maximum mean rank value (44.20). C_4 (45g of coconut) ranked second with the mean rank value (31.60) and C_1 scored mean rank value of 5.65).

Texture

The data in Table 30 reveals that there was significant difference in the scores obtained for the attribute texture. C_3 got the highest mean rank value (44.80) and C_1 obtained the least mean rank value (5.50).

Flavour

It is noted from the Table 30 that C_3 (30g of coconut) scored the maximum mean rank value (43.60) followed by C_5 with a mean rank value of (32.10) while C_1 obtained a minimum mean rank value (5.95). The statistical analysis of data depicted that the difference was significant. The mean rank values ranged from 5.95-43.60.

Taste

Table 10 shows the mean rank value obtained for taste. It ranged from 5.60-44.20. Superior taste was noticed in C_3 (30g of coconut) with mean rank value of 44.20. C_5 (50g of coconut) was placed second with mean rank value (32.85) and least mean rank value was noted for C_1 (10g of coconut).

Overall Acceptability

The overall acceptability scores depicted on the Table 10 reveals that C_3 (addition of 30g coconut) obtained the highest mean rank value (44.10), followed by C_5 with the score (30.80) and C_1 scored least mean rank value (5.70).

When the sensory evaluation as assessed by parameters such as appearance, colour, texture, flavour, taste and overall acceptability were analysed (Table 30) it was observed that C_3 (30g of coconut) secured the highest mean rank values for all the sensory parameters, followed by C_5 (50g of coconut). It is thus concluded that C_3 (30g of coconut) was the best treatment to get the best qualities during cooking of *Avial* mix.

Addition of Coconut Oil into Avial Mix

Like coconut scrapings, coconut oil too is added to enhance the taste and flavour of these traditional dishes. The amount of oil added into *Avial* mix ranged from 1.5ml-5.0ml in five different treatments for 50g of dry mix. The results of sensory evaluation is discussed herewith.

Table 10: Sensory quality of RTC *Avial* mix with varying proportions of coconut

Formulations	Mean rank values					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
C_1 (10 g)	5.95	5.65	5.50	5.95	5.60	5.70
C_2 (20 g)	15.65	16.95	16.70	17.60	18.55	19.10
C_3 (30 g)	43.10	44.20	44.80	43.60	44.20	44.10
C_4 (40 g)	30.10	31.60	27.50	28.25	26.30	27.80
C_5 (50 g)	32.70	29.10	33.00	32.10	32.85	30.80
χ^2	41.86	41.98	44.53	40.02	41.10	39.53
CV	12.77					

Appearance

In the case of *Avial* mix, the mean rank value of appearance ranged from 5.95-40.30. The highest mean rank value (40.30) of appearance was obtained for T_3 (3.5ml). T_1 (1.5ml) was found to be give the least mean rank value (5.95). The difference among these scores were found to be significant.

Colour

The mean rank value obtained for the colour parameter ranged from 5.95-41.05. The statistical analysis depicted that

treatment T_3 received maximum mean rank value (41.05), followed by T_4, mean rank value being 33.00 and T_1 scored the least mean rank value 5.95.

Texture

The statistical data in Table 32 reveals that there was significant difference in the scores obtained for texture. T_3 got highest mean rank value (40.45) and the least mean rank value (5.95) was obtained by T_1.

Flavour

The results further point out that, the difference in the extreme scores was significant. T_3 scored the maximum mean rank value (39.55), followed by T_5 and T_1 secured minimum mean rank value (6.05).

Taste

Table 32 shows the mean rank value obtained for the parameter taste, it ranged from 6.50-38.10. It was observed that T_3 (3.5ml) got the highest mean rank value (38.10), T_5 (5.0ml) was placed second with a mean rank value of 34.35 and T_1 (1.5ml) received the least mean rank value (6.50).

Overall Acceptability

The scores depicted in Table 32 reveals that T_3 with an addition of 3.5ml of oil into the *Avial* mix obtained highest mean rank value (42.70), followed by T_5 with the mean rank value (34.40) and T_1 has scored least mean rank value (9.00).

Results of sensory evaluation are depicted as scores for various parameters such as appearance, colour, texture, flavour, taste and overall acceptability as shown in Table 32. The statistical data reveals that T_3 (3.5ml) secured the highest mean rank value for all the sensory parameters, followed by T_5 (5.0ml). It can thus be concluded that T_3 (3.5ml) was the best treatment to get superior qualities during cooking of *Avial* mix. So T_3 (addition of 3.5ml) was assessed as best treatment for further study.

Table 11: Sensory quality of RTC *Avail* mix with varying proportions of oil

Formulations	Mean rank values					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
T_1 (1.5 ml)	5.95	5.95	5.95	6.05	6.50	9.00
T_2 (2.5 ml)	16.55	15.20	15.50	15.45	15.90	15.25
T_3 (3.5 ml)	40.30	41.05	40.45	39.55	38.10	42.70
T_4 (4.5 ml)	35.90	33.00	31.80	31.80	32.65	25.30
T_5 (5.0 ml)	28.80	32.30	37.65	37.65	34.35	34.40
χ^2	38.87	40.31	40.03	38.59	35.95	34.78
CV	12.77					

Plate 2: Cooked *Avial* mix

Thus the product standardised was found to be acceptable with respect to sensory parameters

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