A Test to Measure the Knowledge Level of Farmers Regarding Processing and Value Addition of Minor Millets

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ABSTRACT

A test was constructed to measure the Knowledge level of millets growers regarding processing and value addition of minor millets in tribal region. The test was developed using scientific procedures including item collection through preliminary screening, item selection based on expert opinions, item analysis (difficulty index, discrimination index), testing reliability and validity of knowledge test and final administration to respondents. A total of 55 items were developed and sent to 114 experts in food science, home science, and extension for a relevancy test using a three-point continuum via Google Forms. Of these, 60 experts provided responses within the stipulated time. Out of 55 items, 42 items were selected for item analysis based on the mean score. Selected items were administrated to 60 millets growers of Kundam block of Jabalpur district, Madhya Pradesh for item analysis. Item difficulty index (Pi) and item discrimination index were used for item analysis. After estimating the item difficulty and discrimination index values, 29 items were tested for the validity by point biserial correlation (rpbis) and also experts' opinion were used. Split-half technique was used for testing the reliability of the scale in which correlation coefficient (r) was found to be 0.810.

Keywords: *Millets, Processing and value addition, Item analysis, Reliability and validity*

INTRODUCTION

Millets are one of the oldest foods and have low carbon emission footprints relative to other major cereals (Dar *et al.,* 2018).These are the small-seeded hardy crops which can grow well in dry zones or rain-fed areas under marginal conditions of soil fertility and moisture. Due to their short growing season, millets can develop from seeds to ready to harvest crops in just about 65 days. Until recently, the crops have been forgotten in terms of conservation, utilization, research, and progress in breeding programs has lagged behind. (Anunciacao *et al.,* 2017). Despite their many benefits, millets have received limited attention in agricultural research, policies and markets. Considering the importance of millets, recently the government of many tropical countries including India and Bangladesh give more emphasis to millets cultivation and improvement. Moreover, Food and Agricultural Organization of the United Nations (FAO) declared 2023 to be the "International Years of Millets (Kheya *et al.,* 2023). Drudgery in processing is a major limitation, as all seeds except finger millet have several layers of hard coats, requiring high abrasive force to break through. Traditional decortication processes using mortar and pestle are physically tedious and are almost exclusively performed by women (Rao and Tonapi, 2021). Appropriate techniques of millet processing lead to the promising and successful utilization of millets in various traditional and convenience health foods. Different processed products from millets have been developed in various categories like popped, flaked, puffed, extruded, roller dried, fermented, malted and composite flours, weaning foods, etc. Some of the processing technologies have promising effects on the food qualities and its nutrition like extrusion of pearl millet in weaning foods enhances the protein digestibility (Cisse *et al.,* 1998). Similarly, germination and probiotic fermentation catalysed in protein profile improvement and mineral availability (Arora *et al.,* 2011).

The adoption of appropriate type of processing technology with suitable type of equipment surely decreases the anti-nutritional constituents, off taste, and off flavours from the millet. Because of this, day by day the consumers for millet are continuously increasing. Also, the

commercial scale production of various value-added products of millets is boosted due to the availability of suitable type of processing machineries and equipment. The advancement in the processing technologies of millets opens a new horizon and it will help to raise millets at competitive level of staple food (Kate and Singh, 2021). Value addition with different ingredients like chocolate, cocoa powder, nuts, and dry fruits resulted in enhanced incorporation of little millet flour in cookies without adversely affecting the sensory profile (Bharati *et al.,*2011). Value-added products from nutri-cereals finger millet reported that food is consumed in combinations. The synergy between foods with others is vital not for taste and delight of eating but also their high nutritional quality and health benefits. The modern trend for the development of new food products aspires for complementary foods to fulfil the widening gap of food availability and nutritional security (Verma and Patel, 2013). To assess and address the knowledge gaps among farmers, the development of a standardized test becomes imperative. Such a test would serve as a diagnostic tool to evaluate their current knowledge on processing and value addition of minor millets. It can also guide targeted interventions, capacity-building programs, and policy recommendations aimed at empowering farmers to maximize the potential of these traditional crops.

MATERIALS AND METHODS

A standard methodology was followed for the development of knowledge test on processing and value addition related aspects adopted by Priyadarshani *et al.,* (2021) and Singh *et al., (*2023) with desired modification.

Items about processing related aspects and value-added food products were collected from the various literature sourcesand discussion held with extension scientist, food science and homescience experts during pilot study. Finally, 55 items were compiled, encompassing topics such as processing, post-harvest technology, storage, and value addition. The items were edited and drafted in such a way that each item highlighted only one idea and represent particular topic and did not have any ambiguity and with a logical sequence.

Jury opinion is first phase of knowledge test development to judge the relevancy of the items for knowledge test. These 55 collected items were mailedto the 114-extension scientist, food science and home science experts for the judgement purpose for relevancy rating on a three-pointcontinuum scale from most relevant (3) to not at all-relevant (1). The experts were requested to check eachitem carefully whether the items were really capable to measure the knowledge of the farmers about processing related aspects and value-addedfood product considered or not and also add/delete or modify those item/items based on the suitability. Final selection of the items was based on relevancy value. Those items were retained for second phase analysis whose relevancy value was higher than the mean value of the items.

Item analysis is a statistical procedure to identify the best items on the basis of item difficulty, item discrimination index and item validity after the jury opinion. The 42 knowledge items consisted of all closed end questions includes 42 "multiple choice" type questions. Those items were carried out with non-sampled 60 tribal millet growers of Kundam block of Jabalpur district, Madhya Pradesh, who were not a part of final administration of the tool and having same socio-economic status where study to be conducted. There was only one correct answer to each question and responses were scored with 1 for each right answer and 0 to each wrong answer or blank response.

The item difficulty index indicated the extent to which an item was difficult to understand. It was worked out as the percentage of the farmers ans wered tems correctly. The measurement of item difficulty assumed to show the difficulty is linearly related with the level of farmer's knowledge about processing related aspects and value-added food products. This index assesses the items neither too easy nor too difficult for the selected farmers. The item difficulty index was calculated by following formula:

$$P_i = n_i/N * 100$$

Where, P = Item difficulty index

ni= No. of respondents answered correctly

N = Total No. of respondents

Item discrimination index is second criteria for itemanalysis to know what extent an item discriminates well informed farmers from poorly informed ones. The scores obtained by 60 farmer respondents were arranged in descending order and divided into sixgroup's i.e. 10 respondents in each group. The groups were named as G1, G2, G3, G4, G5 and G6. For the purpose of item analysis, the middle two groups G3 and G4 were eliminated keeping four extreme groups with high and low scores. The following formula was employed to calculate E1/3:

$$E^{1/3} = \frac{(S1 + S2) - (S5 + S6)}{N/3}$$

Where, S1, S2, S5 and S6 are frequencies of correct answer in the group of G1, G2, G5 and G6, respectively.

N= Total number of respondents in the item Analysis

Validity refers to the appropriateness of the instrument/test. The validity of the test was measured by employing two methods jury opinion and point biserial correlation. Jury opinion ensures content validity of the test by administering every item to experts to evaluate items relevance and appropriateness for the representation of universe by the test. Point bi-serialcorrelation (rpbi) is calculated to know the construct validity of the test that measures internal consistency of the items on the basis of formula given Guilford and Fruchter (1978):

$$r_{pbi} = \frac{MP - MQ}{SD} * \sqrt{pq}$$

Where,

rpbi= point bi- serial correlation coefficient,

MP = Mean of the total score of the respondents who answered the item correctly.

MQ = Mean of the total scores of the respondents who answered the item incorrectly.

SD = Standard deviation of the entire sample,

p = Proportion of the respondents giving correct answer to the item,

q= Proportion of the respondents giving incorrect answer to the item.

(or) q=1-p

RESULTS AND DISCUSSION

The jury opinion method was used to calculate the item relevancy test, wherein items with a relevancy value higher than the mean score of 2.4 were selected. Thus total 42 items were retained for administration to60 millet farmer respondents who are not the part of the final study. Item difficulty index analysis shows that items p value ranged between 0.30 to 0.95 (Table 1).Items whose value ranged between 0.30 to 0.95 were selected for final test (Althouse, 2000). The items fallon less than 0.30 value are supposed to be easy and items with value more than 0.95 are assumed to bevery difficult to answer.

The second criteria for selection of items are basedon item discrimination index (E1/3) that indicated the difference between a well-informed farmer and anunin formed farmer on processing and value addition. A higher discrimination value indicates greater item validity. The acceptable range for item selection was 0.15 to 0.60. The analysis revealed that the discrimination index values of the items ranged from -0.05 to 0.70. Based on the acceptable range, items with E1/3 values outside this range specifically, -0.05 (9th), 0.05 (14th), 0.00 (2nd and 17th), 0.10 (33rd), and 0.70 (41st)were excluded from the test.

The bi-serial correlation (rpbi) was used as a measure of the validity of test items. This metric reflects the relationship between the overall test score and the dichotomous response for each item. The value of bi-serial correlation (rpbi) at least 0.15 is recommended for selection of items in test. From the Table 1, it is cleared that the bi-serial correlation (rpbi) of all items is ranged between 0.16 to 0.76. On the basis of item difficulty, item discrimination and pointbi-serial correlation, total 29 items were included for final test.

Split-half method was used for measuring test reliability due to single administration. In this method, all the 29 items were first randomly arranged and in next step whole items were divided into two halvesone containing the odd items and another one containing even items. Then, correlation coefficient (r) between odd and even items scores was computed and the 'r' value of 0.810 was found to be significant at 1 per cent level of significance which indicates reliability of the test.

Table 1
Difficulty index, discrimination index and point – biserial correlation coefficient of knowledge items related to processing related aspects and value-added food products

Sl.No.	Items	Difficulty Index	Discrimi-nation Index	Rbpis
Processing				
1	Which millets are easier to process due to the absence of husk?	0.92	0.15	0.41
2*	What are the main activities involved in the primary processing of millets?	0.97	0.0	-0.03
3	What is the primary reason for dehulling of minor millets?	0.88	0.35	0.70
4	Which primary processing methods are used to make millets fit for consumption?	0.87	0.30	0.67
5	What is the suitable time period for threshing of minor millets?	0.90	0.20	0.36
6	What are the most advanced methods for threshing of minor millets that can be adopted by farmers?	0.58	0.50	0.48
7	Which of the following is not considered a minor millet?	0.80	0.35	0.56
8	What is the first step in processing of minor millets?	0.93	0.20	0.69
9*	Which traditional method is commonly used for dehulling of minor millets?	0.97	-0.05	-0.05
10	Why is roasting used in the processing of minor millets?	0.32	0.15	0.18
11*	Why is fermentation used in millet processing?	0.27	0.50	0.40
12*	Why is malting (sprouting) used in millet processing?	0.13	0.25	0.35
13*	In millet processing, what is the purpose of pearling?	0.20	0.35	0.41
14*	Which of the following is a by-product of minor millet milling?	0.90	0.05	0.21
15	What is the purpose of soaking millet grains before processing?	0.75	0.30	0.38
16*	Which method is commonly used to enhance the flavour and taste of minor millets?	0.22	0.20	0.30
Value addition				
17*	The term "value addition" in the context of minor millets primarily refers to:	0.68	0.0	0.16
18	Which of the following processing techniques enhances the nutritional and sensory properties of millets for making value-added products?	0.38	0.50	0.36
19	Which of the following is a value-added product made from millets?	0.78	0.45	0.57
20*	Which method is used to convert millets into ready-to-eat flakes?	0.23	0.45	0.41
21	Value addition in minor millets can help in combating which of the following diseases?	0.80	0.55	0.70
22*	What is the purpose of fermenting millet grain before making value-added products?	0.23	0.25	0.26

23	Which of the following processes is typically associated with the value addition of minor millets?	0.35	0.30	0.41
24	Which of the following is a benefit of using millets-based value-added baby food products?	0.93	0.20	0.51
25	What is the primary nutritional benefit of consuming minor millets?	0.65	0.55	0.51
26	Which processing technique is used to enhance the shelf life of millet flour?	0.93	0.20	0.67
27	Millets are considered gluten-free. This makes them suitable for people with:	0.88	0.25	0.30
28	Which of the following method is used to improve the palatability of millet-based products:	0.93	0.20	0.60
29*	What is the purpose of sprouting millet grain before making value-added products?	0.15	0.45	0.47
30	Why is value addition important for tribal farmers who are growing millets?	0.95	0.15	0.29
31	Which traditional millet-based product is commonly made by tribal farmers?	0.80	0.55	0.64
32	How can tribal farmers benefit economically from value-added millet products?	0.95	0.15	0.19
33*	Which process can tribal farmers use to make millets more palatable and appealing to urban consumers?	0.97	0.10	0.16
34	Which traditional preservation technique is commonly used by tribal farmers for millets?	0.33	0.60	0.41
35	How does value addition of millets contribute to food security for tribal communities?	0.72	0.15	0.34
36	What is a common practice among tribal farmers to enhance the marketability of their millet products?	0.87	0.30	0.53
37	Which of the following nutritional benefits is commonly associated with millet-based value-added products?	0.75	0.50	0.64
38	Value-added products made from millets are generally considered to be:	0.93	0.20	0.65
39	What is a common issue with the storage of minor millet products?	0.92	0.25	0.76
40	Which minor millet is commonly used to make traditional Indian dishes like dosa and idli?	0.58	0.50	0.34
41*	Which minor millet is known for its high iron content?	0.62	0.70	0.64
42	Which of the following are value-added products that tribal farmers can produce from millets?	0.92	0.25	0.76

Rejected items on the basis of calculated item difficulty, discrimination index and point bi-serial value

Table 2
Final selected questions for the test

S.N.	Items	Difficulty Index	Discrimi-nation Index	Rbpis
Processing				
1	Which millets are easier to process due to the absence of husk? a) Foxtail, little millet b) Kodo c) barnyard, proso millet d) Sorghum, finger millet, pearl millet	0.92	0.15	0.41
2	What is the primary reason for dehulling of minor millets? a) To improve their flavor b) To make them easier to cook and digest c) To enhance their nutritional value d) To increase their shelf life	0.88	0.35	0.70
3	Which primary processing methods are used to make millets fit for consumption? a) Dehulling, soaking, germination, roasting, drying, polishing, and milling b) harvesting, and storing c) Packaging, labeling, marketing, and selling d) Weighing, mixing, fermenting, and baking	0.87	0.30	0.67
4	What is the suitable time period for threshing of minor millets? a) Immediately after harvesting b) 2-3 days after harvesting c) 7-10 days after harvesting d) 15-20 days after harvesting	0.90	0.20	0.36
5	What are the most advanced methods for threshing of minor millets that can be adopted by farmers? a) Hand threshing b) Animal-drawn threshing c) Dehusking using Decorticator and Dehusking machines d) Other method	0.58	0.50	0.48
6	Which of the following is not considered a minor millet? a) Foxtail millet b) Finger millet c) Sorghum d) Kodo millet	0.80	0.35	0.56
7	What is the first step in processing of minor millets? a) Threshing b) Winnowing c) Dehulling d) Soaking	0.93	0.20	0.69
8	Why is roasting used in the processing of minor millets? a) To increase moisture content b) To enhance flavour and improve texture and increase the shelf life of millets c) To add artificial colours d) To reduce the nutritional value	0.32	0.15	0.18
9	What is the purpose of soaking millet grains before processing? a) To change the colour of the grains b) To hydrate the grains and reduce anti-nutritional factors c) To increase the size of the grains d) To add flavor to the grains	0.75	0.30	0.38

Value addition				
10	Which of the following processing techniques enhances the nutritional and sensory properties of millets for making value-added products? a) Parboiling and Puffing b) Freezing and Grinding c) Cooking and Dehydration d) Soaking and Blending	0.38	0.50	0.36
11	Which of the following is a value-added product made from millets? a) Millet flour b) Millet bread c) Millet snacks d) All of the above	0.78	0.45	0.57
12	Value addition in minor millets can help in combating which of the following diseases? a) Obesity b) Diabetes c) Heart diseases d) All of the above	0.80	0.55	0.70
13	Which of the following processes is typically associated with the value addition of minor millets? a) Milling and polishing b) Freezing c) Roasting and puffing d) Canning	0.35	0.30	0.41
14	Which of the following is a benefit of using millets-based value-added baby food products? a) High gluten content b) Rich in antioxidants c) High in essential nutrients d) High in fats	0.93	0.20	0.51
15	What is the primary nutritional benefit of consuming minor millets? a) High protein content b) High Fiber content c) High fat content d) High carbohydrate content	0.65	0.55	0.51
16	Which processing technique is used to enhance the shelf life of millet flour? a) Refrigeration b) Vacuum packing c) Roasting d) Blanching	0.93	0.20	0.67
17	Millets are considered gluten-free. This makes them suitable for people with: a) Diabetes b) Hypertension c) Celiac disease d) High cholesterol	0.88	0.25	0.30

18	Which of the following method is used to improve the palatability of millet-based products: a) Adding preservatives b) Increasing moisture content c) Using flavour enhancers and spices d) Reducing processing time	0.93	0.20	0.60
19	Why is value addition important for tribal farmers who are growing millets? a) It helps them increase their income by selling higher-value products b) It reduces the labour required for millet cultivation c) It allows them to grow millets with less water d) It shortens the growth cycle of millet crops	0.95	0.15	0.29
20	Which traditional millet-based product is commonly made by tribal farmers? a) Bread b) Porridge c) Pasta d) Pizza	0.80	0.55	0.64
21	How can tribal farmers benefit economically from value-added millet products? a) By selling raw grains b) By producing and marketing millet-based snacks c) By using millets for personal consumption only d) By growing only for local markets	0.95	0.15	0.19
22	Which traditional preservation technique is commonly used by tribal farmers for millets? a) Canning b) Sun drying c) Freezing d) Smoking	0.33	0.60	0.41
23	How does value addition of millets contribute to food security for tribal communities? a) By promoting monoculture b) By enhancing income and dietary diversity c) By reducing food production d) By relying solely on imported foods	0.72	0.15	0.34
24	What is a common practice among tribal farmers to enhance the marketability of their millet products? a) Using synthetic fertilizers b) Implementing value addition techniques like processing and packaging c) Reducing the selling price d) Increasing the planting density of millet crops	0.87	0.30	0.53
25	Which of the following nutritional benefits is commonly associated with millet-based value-added products? a) High in protein and dietary fiber b) Rich in saturated fats and cholesterol c) Low in vitamins and minerals d) High in added sugars and artificial preservatives	0.75	0.50	0.64

26	Value-added products made from millets are generally considered to be: a) Nutritionally inferior b) Nutritionally superior c) High in artificial additives d) Low in essential nutrients	0.93	0.20	0.65
27	What is a common issue with the storage of minor millet products? a) They have a long shelf life and are resistant to pests b) They have a short shelf life and are easily affected by insects and rodents c) They are not susceptible to storage issues d) They improve in quality over time	0.92	0.25	0.76
28	Which minor millet is commonly used to make traditional Indian dishes like dosa and idli? a) Pearl millet b) Finger millet c) Sorghum d) Barnyard millet	0.58	0.50	0.34
29	Which of the following are value-added products that tribal farmers can produce from millets? a) Millet bread, Millet wine, Millet pasta b) Millet beer, Millet biscuits, Millet flour c) Millet juice, Millet chips, Millet soup d) Millet soda, Millet cake, Millet rice	0.92	0.25	0.76

CONCLUSIONS

Knowledge on the processing related aspects and value-added food products significantly contribute towards change in the processing and value addition behaviour. In the present study, a reliable and valid knowledge test was developed by following standardized methodology. The developedknowledge test could be used for assessing the knowledge level across the country among the farmers which could be a testimony for processing and value addition related interventions carried out by KVKs, SAUs and other agencies. Further, this knowledge test also can make a way to plan capacity building programmes for the farmers residing in rural areas by addressing the knowledge gaps in these aspects which will be helpful in income generation by making farmers literate about processing and value-added products.

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