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The Effect of Blending Ratio and Cooking Temperature on the Quality of Weaning Foods Preparation from Bulla, Chickpea and Banana Flour

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Abstract: In this work, ready-to-eat weaning foods were formulated from cereal (chickpea), plant (banana), indigenous family (bulla). Legumes including chickpeas are important crops because of their nutritional quality. They are rich sources of protein and the aim of this study was to develop value added weaning food made by supplementation of chickpea flour, banana flour & bulla flour The purpose of this study was to evaluate the effect of blending ratio and cooking temperature on quality of weaning food on Proximate composition, functional properties was done on seven different blending proportion of chickpea, banana, bulla before the development of weaning porridge then to conduct sensory evaluation by nine hedonic scale points. The result showed that moisture content range from (2.68 – 8.11%), ash content range from (8.01 – 11.21%). The functional analysis showed that water absorption capacity range from (1.12 - 1.84%), oil absorption capacity (1.4 - 2.09%), dispersibility (67.67-84.34%), bulk density (0.63-0.73%). The sensory evaluation showed mean scores range: color (4.76 - 6.39), appearance (4.90-6.23), aroma (4.26-6.51), texture (5.11- 5.93), taste (4.89-6.41), overall acceptability (5.26-6.73). Likewise the sensory evaluation shows that significant differences at P>0.05 were observed for sensory attributes of color, texture, aroma, taste and overall acceptability in chickpea supplemented weaning food up to 10% chickpea flour addition. The weaning food prepared with the optimized mixture had high protein quality and digestibility and could be used to support the growth of infants.

Keywords: Weaning Food, Blending, Functional Properties, Bulla & Chickpea

1. Introduction

Weaning refers to introduction of food other than mother's milk or complete Discontinuation of breast milk or introduction of solids to diet. Generally the term Weaning is used to denote the process in which infant changes from breast milk to mix. Diet [1]. It is the process of expanding the diet to include food and drinks other than breast milk or infant formula as it is the period of infant vulnerability [2]. It represents a period of dietary transition, just when nutritional requirements for growth and brain development are high. Observations of traditional Child feeding practices in many developing countries reveal that, weaning period is the whole period, during which breast milk is being replaced by other foods, usually starts when infant is 4-6 months old and is expected up to the age of two to three years.

Protein energy malnutrition is an important nutritional deficiency condition that often occurs during the critical transitional phase of weaning infants, crippling their physical and mental growth. This could be due to progressive decline in the incidence of breast feeding observed during the last 25-30 years. This condition can be prevented to a large extent by introducing weaning foods of good quality and quantity at right proportion and at right stage [3]. In most developing countries of the world including Ethiopia, where acute shortage of protein is a problem, the occurrence of protein-energy malnutrition (PEM), especially among children and adolescents is common [4].

Thus complementary feeding begins when breast milk alone is no longer sufficient to meet the nutritional requirements of infants and therefore other foods and liquids are needed along with breast milk. Different ingredients from different sources have been utilized in the formulation of weaning food to meet the requirements of the nutrients. A high proportion of the nursing mothers used local ingredients to formulate weaning foods for their babies.

The nutritional compositions of these foods are high quality and suitable as weaning foods, particularly for infants of low income parents who are unable to access commercial weaning foods [5]. Attempts have been made to utilize the ingredients like chickpea, Banana flour and bulla in waning food formulation.

The main challenge that consumers face in their daily menu is that the shortage of protein minerals and vitamins. Most of our baked products are carbohydrate rich but less in protein, minerals and vitamins. In order to produce protein, vitamin and minerals rich products, it is essential to supplement the flours of these products with bulla, banana and chickpea flour. Ethiopia has a considerable chickpea production capacity [6]. However chickpea is underutilized crop in Ethiopia and the same is true for bulla and banana. In addition to using in such traditional foods, it is also better to develop food products from chickpea, banana and bulla. Thus the utilization of these flours as ingredient in porridge products was create new market for the demand of protein, energy and mineral rich products and overcomes the problems stated above. In addition to this no publishing information is available as to which traditional processing methods are optimizing to reduce the effects of the cooking temperature and blending ratio factors to increase availability of the nutrients. In addition, food composition data are need in order to assess foods to promote for health purposes, evaluate the diet, establish locally relevant dietary guidelines, carry out research on the effect of cooking temperature and blending ratio on quality and nutritional contents of food [7].

2. Literature Review

2.1. Bulla

Ensetventricosum (Welw.) Chessman, commonly known as *Enset*, is a monocarp perennial herb originated in Ethiopia. Geographically distributed as a wild species in many parts of Sub-Saharan Africa and Asia, enset is cultivated only in its native indigenous farming systems of South and South-Western Ethiopia. In fact in Ethiopia, E. ventricosum is arguably the most important crop contributing to food security and rural livelihoods for about 1/4 (20 million people) of the country's population [8]. It is a multipurpose plant with a range of utilities including food, feed, construction and medicinal uses [9]. Moreover, enset cultivation improves soil by permanent soil tillage due to its high demands to soil fertility and soil structure [10]

2.2. Health Benefits of Bulla

The enset and its products are used for different nutritional, medical and non-nutritional purposes. The main food product of enset is the starch in the stem and pseudo stem. Koch is the fermented product of these starchy parts and can be baked like bread. These edible products of the enset plant have to be stored for several weeks in order to ferment, and can be stored for several years [11]. Bullais made by dehydrating the juice collected during the decortications of the stem and pseudo stem. The main difference between kocho and bulla is in the fiber content. Bulla consists mainly of refined carbohydrates with very low fiber content and, depending on the duration of fermentation, is less sour than kocho [12]. The preferred use of bulla is as a complementary food, and as a special food given to mothers after delivery, mainly prepared in the form of porridge. The nutrition department of the Attat Hospital in the project area successfully uses bulla as a staple food, combined with other protein, fat and micro-nutrient rich foods, in therapy of severely malnourished children [13].

2.3. Banana

Banana (*Musa paradisiaca*, family Musaceae) is a central fruit crop of the tropical and subtropical regions of the world grown on about 8.8 million hectares [14]. It is possibly the world's oldest cultivated crop [10]. As a diet, banana is an affluent source of carbohydrate with calorific value of 67 calories per 100g fruit and is one of the most well-liked and widely traded fruits across the world [14]. It is one of the tallest herbaceous plants with a pseudo stem. Its tough treelike pliable stem is composed of the sheathing twisting leaf bases, which contains fibers of sufficient strengths to keep the tree upright. In different countries, about 300 varieties of bananas are grown, of which a vast majority are grown in tropical Asia [15].

2.4. Health Benefits of Banana

Hundred grams of ripe Banana provides approximate 116 Kcal energy that makes it a supplementary staple food. Banana has relatively less proteins compared to cereals, absence of other protein rich foods in the diet can cause protein deficiency in people depending mostly on Banana as staple food and it is cooked or ripe Banana are easily digested. Banana is a fair source of Vitamin B, Calcium and also contains about 20% sugars [16].

3. Materials and Methods

3.1. Experimental Site

These experiments were done at Wolkite University College of Engineering and Technology in Food Process Engineering Laboratory.

3.2. Experimental Materials

The raw materials was collected from Gurage Zone in Wolkite town, Ethiopia and the research were conducting to have seen the effect of blending ratio, cooking temperature and time on quality weaning food preparing from bulla, chick pea and banana flour by done all the experiments

3.3. Experimental Design

The product was produced in triplicate and evaluating under random complete block design (RCBD).

Table 1. *Experimental Plan.*

Blending Ratio	Cooking Temperature		
	T1	T2	T3
B1	B1T1	B1T2	B1T3
B2	B2T1	B2T2	B2T3
B3	B3T1	B3T2	B3T3
B4	B4T1	B4T2	B4T3
B5	B5T1	B5T2	B5T3
B6	B6T1	B6T2	B6T3
Control	CT1	CT2	CT3

Where: - B=Blending ratio, C=Control, and T= Temperature
Note:-B1: chickpea, banana and bulla, 50:30:20, B2: chickpea, banana and bulla, 35:15:50, B3: chickpea, banana and bulla, 20:10:70, B4: chickpea, banana and bulla, 30:10:60, B5: chickpea, banana and bulla, 70:15:15, B6: chickpea, banana and bulla, 25:20:55, C: chickpea, banana and bulla, 0:0:100, T1: 60°C, T2: 70°C, T3: 80°C respectively [17].

3.4. Statistical Analysis

Data was analyzed by the analysis of variance (ANOVA) procedures using statically analysis of software (SAS) for windows version 9.0. Least significant differences (LSD) are using for Fisher mean comparison tests. Significance is accepting at (P< 0.05).

4. Results and Discussions

In this research, different functional properties of composite flours were analyzed with using standard procedures (Table 2). Functional properties or characteristics are the intrinsic physico-chemical properties that reflect the complex interaction between the composition, structure, confirmation and physico-chemical properties of protein and other A food components and the nature of environment in which these are associated and measured [18]. The effect of incorporation proportions of different flours on the functional properties of composite flours are discussed as follows [19].

Table 2. *Functional Property of Composite Flour.*

Treatment	WAC (g/g)	OAC (ml/g)	Dispersability (ml)	BD (g/ml)
B1	1.72 ± 0.06^{ba}	1.49 ± 0.06^{b}	72 ± 2^{d}	0.67 ± 0.01^{b}
B2	1.45 ± 0.21^{ba}	2.09 ± 0.18^{a}	77.67 ± 1.52^{b}	0.71 ± 0.01^{a}
B3	$1.55\pm0;.13^{ba}$	2.09 ± 0.28^{a}	78.34 ± 1.52^{b}	0.71 ± 0.01^{a}
B4	1.75 ± 0.78^{ba}	1.54 ± 0.13^{b}	74.34 ± 1.15^{cd}	0.63 ± 0.01^{c}
B5	1.84 ± 0.33^{a}	0.99 ± 0.04^{c}	67.67 ± 1.53^{e}	0.67 ± 0.02^{b}
B6	1.27 ± 0.26^{ba}	1.06 ± 0.13^{c}	76.67 ± 2.52^{cb}	0.73 ± 0.02^{a}
Control	1.12 ± 0.35^{b}	1.4 ± 0.07^{b}	84.34 ± 1.53^{a}	0.72 ± 0.01^{a}
LSD	0.66	0.26	3.03	0.02
CV	24.67	9.91	2.28	1.6

Note: WAC= Water absorption Capacity, OAC= Oil absorption capacity, BD= Bulk Density, within a column, values with different superscript letters have significant (P<0.05) differences.

4.1. Water Absorption Capacity of Flour

The measured water absorption capacity of composite flours is presented in Table 2. The value was water absorption capacity ranged between 1.12 to 1.84g/g for all treatment flours. There is significant difference among the treatment at (P<0.05). The Water absorption capacity was observed highest in B_5 (1.84 g/g) and the lowest in C (1.12 g/g). While composite flours B_{20}, B_{50}, B_{70}, B_{60}, B_{15} and B_{55} bulla had 1.72, 1.45, 1.55, 1.75, 1.84, 1.27 and 1.12 g/g water absorption capacity respectively. From the present study, chickpea flour had highest water absorption capacity (1.84g/g). The result suggests that addition of banana and chickpea flour to bulla affected the amount of water absorption. This could be due to molecular structure of the banana and chickpea which inhibited water absorption, as could be seen from the lower values of water absorption capacity with increase in proportions of other flours to bulla [20]. The increase in the water absorption capacity has always been associated with increase in the amylose leaching and solubility, and loss of starch crystalline structure [21]. The flour with high water absorption may have more hydrophilic constituents such as polysaccharides. Protein has both hydrophilic and hydrophobic nature and therefore they can interact with water in foods. The observed variation in different flours may be due to different protein concentration, their degree of interaction with water and conformational characteristics [22].

4.1.1. Oil Absorption Capacity of Flour

Before preparation of composite flour, oil absorption capacity of bulla, banana, and chickpea flour were analyzed and found as 1.4, 1, and 2ml/g, respectively. The measured oil absorption capacities of flours are presented in Table 2. The values were 1.49, 2.09, 2.09, 1.54, 0.99, 1.06 and 1.4 ml/g B1, B2, B3, B4, B5, B6 and control respectively. There is significant difference among the treatment at (P<0.05). The composite flours (B_2 and B_3) had highest oil absorption capacity (2.09 ml/g for both) and lowest for B_5 (0.99ml/g) as compared to bulla (1.4ml/g) [23]. It is clear that the oil absorption capacities of composite flours (B_2 and B_3) increased with increase in the proportion of other flours. The presence of high fat content in flours might have affected adversely the oil absorption capacities of the composite flours. The oil absorption capacities were found to be insignificant to each other at P<0.05 level of significance [24]. Therefore the possible reason for increase in the oil absorption capacities of composite flours after incorporation of chickpea flour. However, the flours in the present study are potentially useful in structural interaction in food especially in flavor retention, improvement of palatability and extension of shelf life particularly in bakery or meet products where fat absorption is desired [25]. The major chemical component affecting oil absorption capacities is protein which is composed of both hydrophilic and hydrophobic parts. Non-polar amino acid side chains can form hydrophobic interaction with hydrocarbon chains of lipids [26].

4.1.2. Bulk Density of Flour

The measured bulk density of composite flours is presented in Table 2. The bulk densities of flours ranged from 0.63 g/ml to 0.73 g/ml. The highest bulk density was observed B_6, C, B_3 andB_2 flour followed by B_1 flour (0.67g/ml), B_5 flour (0.67 g/ml) and lowest for B_4 (0.63 g/ml). The present study revealed that bulk density depends on the particle size and initial moisture content of flours [27]. Bulk density of composite flour increased with increase in the incorporation of different flours with bulla. It is clear that decreased the proportion of bulla increase the bulk density of composite flours. The high bulk density of flour suggests their suitability for use in food preparations. On contrast, low bulk density would be an advantage in the formulation of complementary [28]. Therefore, present study suggests that highest bulk density of composite flour (B_6, C, B_3 and B_2) suggests its suitability to be used as thickener in food products and for use in food preparation since it help to reduce paste thickness which is an important factor in convalescent and child feeding. Bulk density of composite flours increased significantly with increase in the incorporation of banana and chickpea flour with bulla [6].

4.1.3. Dispersability of Flour

Before preparation of composite flour, Dispersability of bulla, banana, and chickpea flour were analyzed and found as 84, 74, and 64 ml, respectively. The measured Dispersability of composite flours is presented in Table 3. Dispersability which ranged from 67.67 ml to 84.34 ml increased as B_5 and control level increased. As the chickpea increases the composite flour of Dispersability increased. Dispersability is an index that measures how well flour or flour blends can be rehydrated with water [29]. All the flour blends have relatively high dispersibility signifying that they will reconstitute easily to fine consistent dough or pudding during mixing [30].

Table 3. *Proximate Composition of Flour.*

Treatment	M.C (%)	Ash (%)
B1	2.68 ± 0.04^{e}	8.01 ± 0.1^{f}
B2	3.84 ± 0.15^{c}	8.7 ± 0.06^{e}
B3	4.33 ± 0.11^{b}	9.45 ± 0.07^{d}
B4	3.11 ± 0.09^{d}	8.53 ± 0.01^{e}
B5	2.09 ± 0.07^{f}	11.21 ± 0.19^{a}
B6	4.4 ± 0.1^{b}	10.28 ± 0.32^{c}
Control	8.11 ± 0.1^{a}	10.72 ± 0.29^{b}
LSD	0.18	0.33
CV	2.48	1.98

Note: M.C=Moisture content, LSD= Least Significant Difference, CV= Coefficient of variance

Within a column, values with different superscript letters have significant ($P<0.05$) differences.

4.1.4. Moisture Content of Flour

Before preparation of composite flour, moisture content of bulla, banana, and chickpea flour were analyzed and found as 8.11%, 1%, and 2.1%, respectively. The moisture content (d.b.) for bulla and composite flours are presented in Table 3. This ranged from 2.09% to 8.11% depending upon the blending ratio. The moisture content of composite flours i.e. B_1 (2.68%), B_2 (3.84%), B_3 (4.33%), B_4 (3.11%), B_5 (2.09%), B_6 (4.4%) and C (8.11%) were also determined. From the Table 4, it is clear that the moisture content of composite flours decreased with increase in proportions of other flours [31]. The moisture content of composite flour was highly affected by blending of banana and chickpea flours. The highest moisture content was observed for Control (8.11%) and lowest for B_5 (2.09%) in the composite flours. The study revealed that moisture content of composite flours decreased with decrease in proportions of bulla [32].

4.1.5. Ash Content of Flour

In this experiment the ash content was in the order of B_5 > C>B_6 >B_3 >B_2 >B_4 >B_1 with value of 11.21%, 10.72%, 10.28%, 9.45%, 8.7%, 8.53%, and 8.01% respectively. The high ash content is B_5 indicates that high mineral content compared with other blend proportions. So B_5 is best ratio based on their ash content value it is good for infant formulation than that of control. Ash content is a measure of the total amount of minerals present within a food [33]. The higher the ash content, the higher the minerals content in the food. Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, which provides mineral content, a measure of the total amount specific inorganic components within a food. The ash content of each food will be different due to the different mineral content in each food and the origin of the food [34].

4.2. Sensory Analysis of Porridge

The study was conducted to determine the acceptability of porridge developed from various proportions of chickpea, bulla and banana flour. Porridge made from the composite flours was evaluated by 15 untrained panelists. The panelist evaluated the products based on how much they liked the appearance, color, aroma, taste, texture and overall acceptability. A 9-point hedonic scale (1 representing *dislike extremely* and 9 representing *like extremely*) was used for the evaluation. Panelists were provided with a piece of unsalted porridge and still water to refresh their palate after tasting each sample. Porridge made from bulla was used as a control [35]. The data obtained from the various experiments were recorded during the study and were subjected to statistical analysis as per method of "Analysis of Variance" by factorial Randomized Complete Block Design (factorial RCBD). The significant difference between the means was tested against the critical difference at 5% level of significance [20]. Statically analysis of soft ware (SAS) was used for analyze the recorded data. Results on the mean scores for the sensory attributes of the porridge [36].

Table 4. *Sensory Analysis of porridge.*

Treatment	Color	Appearance	Aroma	Texture	Taste	OverallAcc
B1T1	5.13 ± 0.11^{ba}	6.09 ± 0.59^{ba}	5.71 ± 0.57^{bdac}	5.42 ± 0.90^{a}	5.68 ± 0.94^{a}	6.32 ± 0.50^{bac}
B1T2	5.37 ± 0.15^{ba}	5.57 ± 0.33^{ba}	6.11 ± 1.25^{bac}	5.54 ± 0.30^{a}	5.56 ± 0.71^{a}	6.42 ± 0.58^{bac}
B1T3	5.55 ± 1.33^{ba}	5.92 ± 0.88^{ba}	5.81 ± 1.11^{bdac}	5.52 ± 1.07^{a}	6.41 ± 0.96^{a}	6.73 ± 0.62^{a}
B2T1	5.59 ± 0.35^{ba}	4.98 ± 0.06^{ba}	5.46 ± 0.30^{bdac}	5.52 ± 0.41^{a}	5.27 ± 0.64^{a}	5.53 ± 0.41^{bc}
B2T2	5.90 ± 1.04^{ba}	6.17 ± 0.67^{ba}	5.69 ± 0.66^{bdac}	5.47 ± 0.88^{a}	5.73 ± 0.96^{a}	6.14 ± 0.48^{bac}
B2T3	5.25 ± 1.22^{ba}	5.19 ± 1.04^{ba}	5.05 ± 0.48^{dec}	5.43 ± 1.05^{a}	5.52 ± 0.94^{a}	5.33 ± 0.58^{c}
B3T1	5.19 ± 0.21^{ba}	5.54 ± 0.89^{ba}	5.08 ± 0.33^{dec}	5.50 ± 0.58^{a}	5.37 ± 0.69^{a}	5.33 ± 0.63^{bc}
B3T2	5.91 ± 1.69^{ba}	5.73 ± 0.71^{ba}	5.32 ± 1.15^{bdec}	5.68 ± 0.47^{a}	5.84 ± 0.65^{a}	6.09 ± 0.35^{bac}
B3T3	5.36 ± 0.32^{ba}	5.61 ± 0.50^{ba}	5.95 ± 0.71^{bdac}	5.20 ± 0.19^{a}	6.03 ± 0.59^{a}	5.84 ± 1.17^{bac}
B4T1	5.52 ± 0.44^{ba}	6.23 ± 0.33^{a}	6.32 ± 0.32^{ba}	5.36 ± 1.29^{a}	6.30 ± 0.82^{a}	6.42 ± 0.99^{bac}
B4T2	6.39 ± 0.92^{a}	5.03 ± 0.58^{ba}	5.66 ± 0.38^{bdac}	5.25 ± 0.22^{a}	5.64 ± 0.55^{a}	5.79 ± 0.88^{bac}
B4T3	5.56 ± 0.72^{ba}	5.57 ± 0.75^{ba}	6.51 ± 0.57^{a}	5.82 ± 0.44^{a}	6.08 ± 0.96^{a}	6.04 ± 0.90^{bac}
B5T1	6.11 ± 0.36^{ba}	5.44 ± 0.89^{ba}	5.04 ± 0.42^{dec}	5.37 ± 0.94^{a}	5.45 ± 0.76^{a}	5.99 ± 0.78^{bac}
B5T2	5.69 ± 0.52^{ba}	4.92 ± 0.62^{b}	5.11 ± 0.54^{dec}	5.08 ± 0.52^{a}	5.37 ± 0.55^{a}	5.46 ± 0.44^{bc}
B5T3	5.71 ± 0.71^{ba}	5.41 ± 0.38^{ba}	5.36 ± 0.60^{bdec}	5.58 ± 0.58^{a}	5.73 ± 0.90^{a}	5.57 ± 0.84^{bac}
B6T1	6.13 ± 1.10^{a}	5.43 ± 0.94^{ba}	5.80 ± 1.02^{bdac}	5.11 ± 0.21^{a}	5.72 ± 1.13^{a}	6.25 ± 0.91^{bac}
B6T2	6.09 ± 0.94^{ba}	5.74 ± 1.05^{ba}	5.89 ± 0.60^{bdac}	5.77 ± 0.70^{a}	6.07 ± 1.18^{a}	6.42 ± 1.00^{bac}
B6T3	5.58 ± 0.49^{ba}	5.05 ± 0.99^{ba}	5.53 ± 0.51^{bdac}	5.93 ± 0.81^{a}	5.74 ± 0.47^{a}	5.71 ± 0.58^{bac}
CT1	5.48 ± 0.83^{ba}	5.20 ± 1.23^{ba}	5.71 ± 0.87^{bdac}	5.62 ± 0.44^{a}	5.83 ± 0.73^{a}	6.53 ± 0.56^{ba}
CT2	4.76 ± 0.28^{b}	4.90 ± 0.92^{b}	4.89 ± 0.40^{de}	5.24 ± 0.86^{a}	5.56 ± 0.84^{a}	5.93 ± 0.81^{bac}
CT3	5.61 ± 0.97^{ba}	4.91 ± 0.71^{b}	4.26 ± 0.47^{e}	5.45 ± 1.02^{a}	4.89 ± 1.09^{a}	5.26 ± 0.60^{c}
LSD	1.35	1.14	1.13	1.28	1.31	1.20
CV	14.63	14.11	12.45	14.21	10	12.25

Color is very significant parameter in judging well porridge prepared. It doesn't only reflect the suitable raw material used for the preparation but also provides information about the formulation and quality of the product [37]. The mean score of porridge color was decreased from 6.39 to 4.76 as the level of bulla flour addition increased from B_4T_2 to CT_2 (Table 4). This indicates that supplementation of banana and chickpea with bulla up to 60% of cooking temperature at 70℃ for porridge was acceptable with respect to color.

4.2.1. Appearance

The mean score of porridge appearance was decreased from 6.23 to 4.90 as the level of bulla flour addition increased from B_4T_1 to CT_2 (Table 4). This indicates that supplementation of banana and chickpea with bulla up to 60% of cooking temperature at 60℃ for porridge was acceptable with respect to appearance [38].

4.2.2. Aroma

The mean aroma score of the porridge was significantly affected by blend proportion and the result shows that the aroma score decreased from 6.51 to 4.26 as the level of bulla flour addition increased in the porridge. Hence 60% bulla (B_4T_3) flour addition porridge was acceptable with respect to aroma [39].

4.2.3. Texture

The result shows that the mean texture score of bulla supplemented porridge was decreased from 5.93 to 5.11 with increasing bulla substitution. Consequently the porridge made by 55% (B_6T_3) of bulla addition resulted in porridge with other blend of such as banana and chickpea have better texture than the control porridge ratio [40].

4.2.4. Taste

Results of the study revealed that porridge made from B_1T_3 flour were observed highest taste score of 6.41 followed by B_4T_1 (6.30) while lowest for CT_3 (4.89). Taste score decreased with increasing bulla in the formulation of porridge [41].

4.2.5. Overall Acceptability

The sensorial data for effect on overall acceptability of porridge are given in Table 4. Highest overall acceptability was scored for B_1 T_3 porridge (6.73) followed by CT_1 (6.53) while lowest for control porridge by temperature difference CT_3 (5.26) just after preparing and cooling [42]. Sensorial data revealed that overall acceptability of porridge increased with increasing incorporation of chickpea and banana flour with bulla in the formulation of porridge. In general, overall acceptability of porridge depends on the individual data of different sensory attributes like color, aroma, taste, appearance and texture. In case of composite flour porridge, overall acceptability was awarded highest for B_1T_3 as compared to control porridge [43]. All porridge coincided in the range of like 'like slightly' to 'like very much' for porridge made from composite flours, while 'neither like nor dislike' to 'like moderately' for control porridge [44].

5. Conclusions

The study made an attempt to identify porridge formulations using chickpea, bulla and banana composite flours. The functional properties of bulla and composite flours such as water absorption capacity, oil absorption capacity, dispersibility and bulk density were increased with increase in the incorporation of other flours with bulla. The result showed that the addition of chickpea and banana flour to bulla in the proportion of 10 to 70% for each produced acceptable porridge and also functionality of the flour was not affected. Sensorial data revealed that Overall acceptability of porridge increased with increasing in the incorporation of banana and chickpea flour with bulla in the formulation of porridge. The porridge prepared with the flour ratio of 50: 30: 20 liked most of the panelists. But according to nutritional quality B_5 (70 chickpea, 15 banana and 15 bulla) at temperature 70°C is better for infant food formulation. Incorporation of above flours to bulla would therefore be an effective method of cost reduction of porridge and other allied products and solving malnutrition problems in children in Ethiopia

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