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Traditional production technology, consumption and quality attributes of toubani: A ready-to-eat legume food from West Africa

Franck Hongbété[1], Abdoul-Kader Tidjani[1] and Janvier Mêlégnonfan Kindossi[1,2]*

[1]Département de Nutrition et Sciences Agroalimentaires, Faculté d'Agronomie, Université de Parakou, BP : 123 Parakou, Bénin.
[2]Laboratoire de Biochimie Microbienne et de Biotechnologie Alimentaire, University of Abomey-Calavi, 01 B.P. 526 Cotonou, Benin.

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Toubani is a traditional ready-to-eat legume food, consumed as staple food with stews. This study investigated the socio-cultural profile of stakeholders, the traditional processing techniques and sensory quality attributes. For this purpose, a survey was carried out in two municipalities using a questionnaire managed to stakeholders. The results showed that toubani production is exclusively undertaken by women while consumption is by all classes of people. Three types of Toubani were identified, varying in their raw materials and processing technologies: the use of cowpea as a single element or in combination with yam. The sensory quality attributes of Toubani with regards to consumers' preference was linked to the perception of processors.

Key words: Toubani, cowpea, yam, quality attributes, production, consumption.

INTRODUCTION

Cowpea is the most economically important indigenous African legume crop. Cowpeas are of vital importance to livelihood of several million people in West and central Africa (Gómez, 2004). Cowpea is a plant source with high protein, containing 20 to 30 g of protein per 100 g of dry weight and very popular in West Africa. It also contains high concentrations of carbohydrate, vitamins and minerals (Abioye et al., 2015). Cowpea, legume grain (*Vigna unguiculata* (L) Walp), is the main source of income, it stands as the second most important starchy food for people after maize (Madodé, 2012). In Benin, this legume is an important component in the religious rites and is one of the sacred meal offering to the ancestral spirits (Dansi et al., 2008). Different traditional African meals and seasonings are made up of cowpea, among them are homemade weaning foods (Lambot, 2002). It is an important food for children as well as adults and is prepared in a variety form of dishes.

*Corresponding author. E-mail: jkindossi@gmail.com.

Cowpea grains are often cooked alone (Abobo, Adowè) or ground into flour and made into cake (Ata, Akara) or steamed (Madodé et al., 2011; Taiwo, 1998). The consumption of this legume is particularly important in Benin since protein malnutrition is major health problem in West Africa. Grains legumes are low-cost source of protein than animal protein (Lateef et al., 2010; Egounlety and Aworh, 2003). In the North Benin, steam-cooked mixed cowpea with yam paste product is popularly called Toubani. This flavoury food is often consumed with spices and chopped onions or soup. There is however dearth of information on the processing technology, raw materials used and can lead to variation in nutritional composition of this food. To overcome these lacks, this investigation aims to gather information on the traditional processing techniques, problems associated with processing, consumption, and quality attributes of toubani through stakeholder knowledge and perception.

MATERIALS AND METHODS

Sampling of stakeholders and data collection

The survey was conducted in two localities in the North Benin, especially Parakou municipality (latitude 9°21'N and longitude 2°36'E) in the Borgou Department and Malanville municipality (latitude 11°12'N and longitude 2°28'E) in Alibori Department where toubani is commonly consumed. The sample size was determined according to Dagnelie (1998) as described by Chadare et al. (2008). Eligible interviewed stakeholders were selected by ranking toubani processors and consumers. A total of 140 people (40 processors-sellers, 100 consumers) from different socio-cultural groups and localities were interviewed.

Survey tool design

A questionnaire was designed to collect data on toubani production and consumption. Demographic data related to gender, age, marital status, and academic qualifications of processors were collected. Then, technical data on the process were gathered, including raw materials and ingredients used, type of toubani and constraints related to processing. Other information collected included sensory quality attributes of toubani, shelf life and safety problems. The survey was carried out through individual interviews or focus group discussions (2-4 interviewed) from both processors and consumers.

Statistical analysis

Survey data were entered in the Sphinx plus^2 software (Sphinx Survey Plus^2, Eureka) and were analysed for descriptive statistical patterns and trends. In addition, multivariate analyses were performed on the types of toubani and quality attributes as perceived by stakeholders using Statistica (version 7.1, StatSoft France, 2006).

RESULTS AND DISCUSSION

Socio-cultural profile of Toubani processors

The production and commercialization of toubani are exclusively female activities (100%) (Table 1). This is similar to what is generally obtained in Africa countries where women play very significant roles in traditional food production especially based on street food vendor activities. Similarly, Kindossi et al. (2012) also found women predominance amongst traditional processing technique for food. The processors surveyed were aged between 18 and over 50 years; 64.3% of them were between 18 and 30 years, while 35% are between 31 and over 50 years. These percentages show that the younger generation is more interested in this activity. From the survey, it was observed that the transmission of Toubani production technology is matrilineal; 90% of processors inherited the process techniques, the know-how and the remaining received the knowledge from their friend (10% of processors interviewed). The major socio cultural groups were Bariba (70%) followed by Nagot (18.5%), Dendi (8.5%) and Yom (3%). This confirms the general perception of consumers as to the origin of the product commonly recognized as a dish which draws out its source from bariba people who lived in the northern region of Benin. A relative proportion of processor-sellers of toubani (70%) were found to be illiterate, while the rest (30%) did not finish primary school. The production and commercialisation of toubani are an income generating activity for them. In Parakou and Malanville, toubani is sold in the morning and the evening at the edge of streets and other public places.

Table 1. Demographic characteristic of toubani processor and sellers.

Variables	Frequency (n=140)	Percentage
Ages (years)		
18-25	40	28.6
26-30	50	35.7
31-40	37	26
41-50	10	7
≥ 50	3	2
Gender		
Females	140	100
Educational status		
Illiterate (non-academic qualification)	98	70
Primary school	42	30
Socio cultural group		
Bariba	98	70
Nagot	26	18.5
Dendi	12	8.5
Yom	4	3

n: Number of processors interviewed.

Processing technique for Toubani

Raw materials and ingredients used

Raw materials used in toubani production include cowpea *(Vigna unguiculata*) singly or in combination with yam (*Dioscorea* sp.). The ingredients added to produce toubani were salt, potash, seasonings in various ratio according to processors. According to Madodé et al. (2011), certain types of potash modified the colour and can improve the iron content of the finished product, which was appreciated according to the region. Uzogara et al. (1988) clarified the change in colour obtained with the potash by a browning process due to the Maillard reaction and oxidation of the cowpea pigments. The preference for the use of these raw materials was 100% for cowpea processing and a mixture of cowpea with dried yam (55%). Similar information was gathered on moinmoin, a Nigerian steamed cowpea paste for which the cowpea grains were used singly or combined with maize (*Zea mays*) or with cassava flour (*Manihot esculenta*) (Olayiwola et al., 2012; Akusu and Kiin-Kabari, 2012; Ayode et al., 2012; Olapade and Adetuyi, 2007; Hongbété et al., 2011). In this study, the possible raw material combinations were dried yams. The mixing ratio of cowpea grains and dried yam differs from one locality to another and between processors within the same locality. This dissimilarity of ratio of cowpea and dried yam between localities and processors should affect the finished product quality. According to processors, the reasons for mixing the cowpea/yam included interest in improving consistency, increasing nutrient content and net profit improvement. Most processors (75%) used dried yam tuber (*Dioscorea rotundata*) of the kokoro type cultivar or dried yam tuber (*Dioscorea alata*) of Florido cultivar (25%). They reported that the yams from the kokoro group are more preferred by consumer than that of Florido. Also, other studies pointed out that yams tubers of kokoro group were mostly used for dried yam processing and its thick paste (amala) is generally the best preferred by consumers (Akissoé et al., 2001; Mestres et al., 2004). However, illegal substances such as fumigant type topstoxin and endosulfan (claimed by 33.3 and 29.3% of processors, respectively) are incorporated directly in cowpea grains and dried yams to control insects that attack during storage, while to ensure adequate dispersion, fumigants are often applied with air-moving equipment. Moreover, this practice observed during the survey can involve toxicity effect and extent contamination to stored products, finished products and even towards human beings.

Toubani is produced throughout the year with quantity of cowpea grains varying from 1 to 50 kg per week and per processor. Toubani is produced by majority of the respondents more than once a week. The processors (12.4%) of Toubani from cowpea and 25.9% from cowpea/yam produce two to three times per week, while 60% of processors of Toubani from cowpea grain, 68.9% from mixture cowpea/yam produce toubani more than three times per week.

Technology of Toubani production

Traditional toubani processing operations were reported to be laborious and time consuming. Three processing techniques were identified, these are toubani from non dehulled cowpea (ndc), toubani from dehulled cowpea (dc) and toubani from mixture cowpea and yam (c/y). Cowpea is processed into toubani using the diagram shown in Figure 1. The cowpea grains are sorted, cleaned of dust, sand and plant debris. The cleaned grains are washed and steeped in water at room temperature (26 to 35°C) to soften the hull to ease its removal in the production of dehulled flour (Figure 1A). This is however skipped from production of non dehulled cowpea flour (Figure 1B) and mixed cowpea/yam flour (Figure 1C). The dehulled steeped grains are drained and sun dried for 4 days. The dried dehulled cowpea grains, non dehulled cowpea grains or mixture cowpea grains with dried yams are milled followed by kneading (whipping) of each flour with water. During the kneading, potash, salt are added and homogenised. The resulting dough is then packaged using different recycled materials like milk tin, tomato tin, plastic cup. The packaged dough is then steam-cooked for 15 to 30 min.

Constraints related to processing

The constraints to toubani production were identified as sorting and cleaning, the laboriousness of the dehulling step and the kneading. Millers frequently refuse grinding because of the residual and undesirable beany odour on other miller products later. Mill need to be cleaned thoroughly after cowpea grinding, and so cleaning costs were indirectly demanded by extra charge.

Shelf life of toubani and safety problems

The shelf life of toubani varies depending on the process and the quality of the raw material and ingredients. Toubani processors (94.3% respondents) reported that toubani is produced daily for immediate consumption. So, it is complicated for them to preserve it for more than 24 h at ambiant temperature. The toubani is cooked by steaming, it could be free from any biologically damaging agent if it is well packaged with adequate packaging, its shelf life should not be short as observed from the survey. Similar short shelf life was recorded among African traditional dishes such as kunu and cowpea dishes (Gaffa et al., 2002; Madodé et al., 2011).

Additionally, the safety problems recorded with toubani

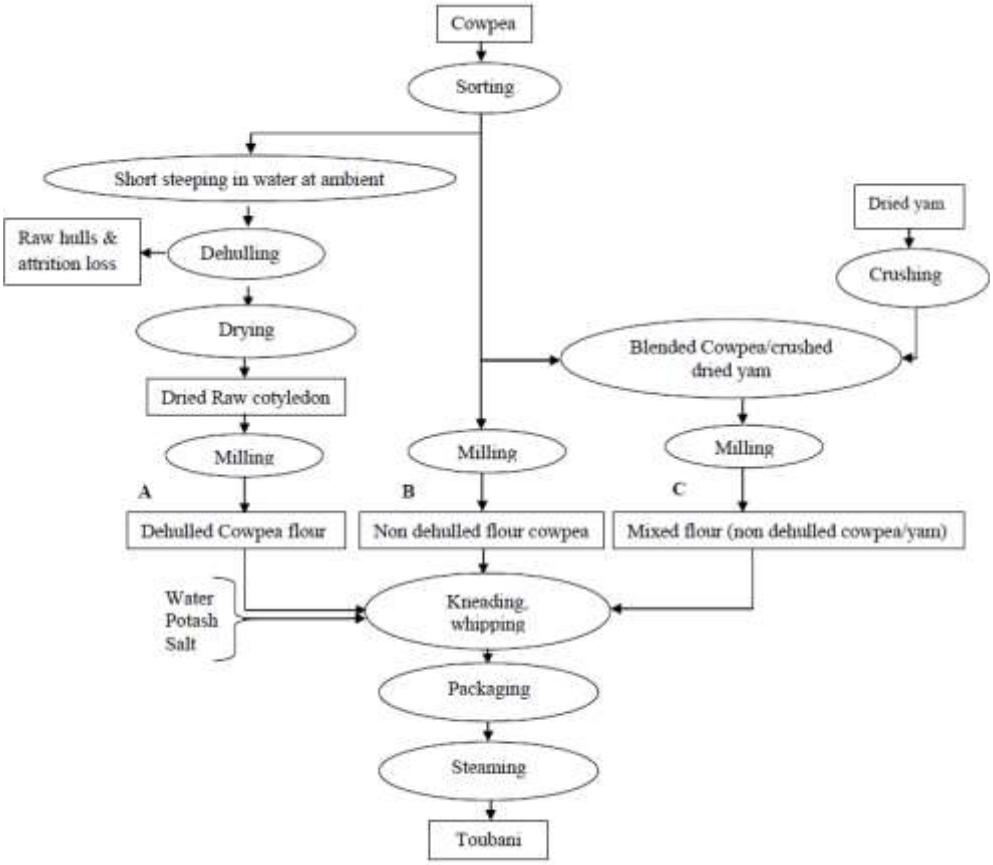

Figure 1. Flow sheet of toubani processing.

traditional production are related to the variability of theunit operations and the unhygienic condition of the production environment. The steeping and dehulling operations were not practised by certain processors while these operations are going on. Though the dehulling is a tedious and time consuming operation, it involves the removal of the hulls of cowpea grains steeped by presenting significant points such as reduction of tannin content, good appearance, high texture, cooking quality and digestibility of the grains (Clark et al., 2014). Elsewhere, the steeping, dehulling and drying parameters (temperature, duration and moisture) vary within and between processors. Also, the dehulled cowpea grain is sun dried, so the accomplishment depends on the weather, generally on the sunshine intensity. Furthermore, the cooking time and the quantity of ingredients varied from one processor to another. Therefore, there is a need for the process standardization.

Forms and frequency of toubani consumption

For consumers (62.8% of female and 37.2% of male, aged between 18 and 60), toubani is a ready-to-eat staple food eaten with stew or blend of oil, pepper and pieces of fresh onion. Most consumers frequently eat non dehulled cowpea toubani (19.6-28.6 %), dehulled cowpea toubani (1.3-32.7 %) and mixture of cowpea/yam toubani (5.3 to 38.3%) once or several times per week (Table 3). With regards to the occasion of consumption, these products are consumed at breakfast (25.3 to 28.5%), lunch (25.1 to 47.6%), and dinner (15.0 to 20.8%).

Quality perception of toubani

Processors and consumers gave their opinion on the significant quality attributes based on their observations for toubani, these are appearance, taste, colour, soft to the feel, smooth texture, springiness and beany flavour, etc. (Table 2). According to the two stakeholders (> 50% of respondents), toubani is recognized as being juiciness, salty in taste, have springiness, beany taste and beany flavour. Then, toubani made from cowpea alone is supposed to be slightly hard for 50.1 and 46.3% of the processors and 56.3 and 52.6% of consumers for non dehulled and dehulled cowpea toubani, respectively. Non-dehulled cowpea toubani and mixed cowpea/yam toubani should have a brownish colour (91.4 and 76.7%

Table 2. Sensory quality attributes of each type of toubani according to stakeholders (%).

Sensory attributes of Toubani	Processors			Consumers		
	non dehulled Cowpea (n= 20)	Dehulled cowpea (n=10)	mixture cowpea/yam (n=10)	Non dehulled Cowpea (n=80)	Dehulled cowpea (n=15)	mixture cowpea/yam (n=35)
Ashen colour	48.6	74.3	10.0	49.8	72.6	19.7
Brownish colour	91.4	37.1	76.7	85.3	23.3	82.3
Beany taste	78.6	82.9	50.0	77.9	82.5	42.2
Juiciness	82.6	65.8	74.4	94.5	74.1	84.4
Salty taste	75.3	70.0	71.2	85.3	80.1	82.3
Soft to the feel	52.7	42.7	91.7	61.5	39.6	96.6
Smooth texture	35.9	81.4	46.7	28.5	62.5	67.9
Springiness	50.9	58.5	89.6	54.5	61.4	86.7
Slightly hard	50.1	46.3	18.5	56.3	52.6	31.6
Mouth feel	13.6	45.9	71.7	18.2	51.1	81
Beany flavour	82.9	64.3	46.8	93.1	72.6	51.1
Very well cooked	99.0	98.0	100	100	100	100

n: Number of stakeholders interviewed.

Table 3. Consumption frequency of toubani (%).

Toubani	Non-dehulled cowpea	dehulled Cowpea	Mix cowpea /yam
Consumption frequency (times per week)			
Six-seven	19.6	1.3	5.3
Four – Five	24.1	27.4	17.2
Two –three	28.2	30.2	38.3
Once	24.6	32.7	24.4
Rarely	3.5	5.4	13.1
Occasion of consumption			
Breakfast	25.3	27.4	28.5
Lunch	47.6	25.1	39.4
Dinner	17.7	15.0	20.8

of processors and 85.3 and 82.3% of consumers, respectively). The Toubani of dehulled cowpea is considered to have an ashen colour (74.3% for processors and 85.3% for consumers) and smooth texture (81.4% producers and 62.5% of consumers). Also, mixed cowpea/yam toubani is softer to the feel (91.7% of processors and 96.6% of consumers) than other toubani from cowpea alone.

The relationship between the sensory quality attributes and stakeholders is illustrated by the principal component analysis (PCA) plot in Figure 2. The PCA revealed that 85.06% of variability in quality attribute perception could be explained by the first two axes, as 52.41% by the first principal component (Axis 1) and 32.65% by the second one (Axis 2) (Figure 2). All processors and consumers agreed on the required qualities attributes of Toubani. The PCA plot indicated that consumers were directly aligned to the perception of processors on quality criteria of each type of Toubani. So, the PCA shows three groups of stakeholders in relation to perception of sensory quality attributes of Toubani (Figure 2): the first relates to processors and consumers of Toubani (Pc/y and Cc/y) from mixed cowpea/yam (34.17%); the second group contains processors and consumers of toubani (Pdc and Cdc) from dehulled cowpea (29.65%) and the third group, processors and consumers of toubani (Pndc and Cndc) from non dehulled cowpea (24.30%). The PCA indicated that the preference of consumers was linked to the perception of processors. Each group seem to have a specific perception of the quality criteria of toubani. Then, for processors and consumers, dehulled cowpea toubani should have ashen colour, whereas non dehulled cowpea toubani should be slightly hard and the mixed cowpea/yam toubani should be soft to the feeling, have

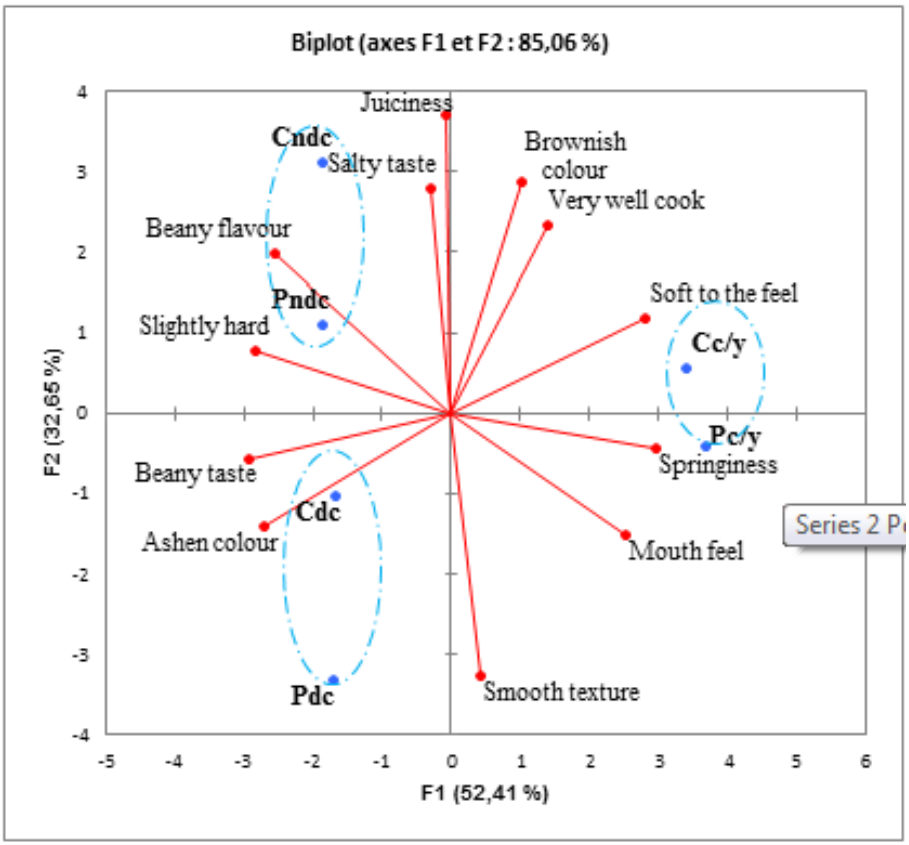

Figure 2. Relation between sensory quality attributes of toubani, linking to stakeholders characteristics. Pndc: Processors of toubani from non dehulled cowpea; Pdc: processors of toubani from dehulled cowpea; Pc/y: processors of toubani from blended non dehulled cowpea and yam Cndc: consumers of toubani from non dehulled cowpea; Cdc: consumers of toubani from dehulled cowpea; Cc/y: consumers of toubani from blended non dehulled cowpea and yam.

springiness and mouth feel. In addition, popular processors of toubani have a significant experience and particular knowledge on production by using more salt and prepared for with long cooking time. Also, the PCA revealed that some quality attributes were linked (Table 4). As shown in the result, the slight hardness of dehulled cowpea toubani was significantly and positively correlated with ashen colour ($r = 0.83$, $p < 0.05$), with beany taste ($r = 0.92$, $p < 0.05$) and beany flavour ($r = 0.90$, $p < 0.05$); and significantly and negatively correlated with soft to the feeling ($r = -0.82$, $p < 0.05$), with springiness ($r = -0.93$, $p < 0.05$) and mouth feel ($r = -0.79$, $p < 0.05$). These correlations indicate that the absence of cowpea hull impact ashen colour on the finished product but inhibited its softening. The salty taste was significantly and positively correlated with juiciness ($r = 0.82$, $p < 0.05$) and beany flavour ($r = 0.46$, $p < 0.05$). This correlation indicates that the salt and potash were used to improve water uptake, tenderness, succulence, cooking time and digestibility of the toubani. In addition, salt is retained as a key interaction with bean flavor that acts as positive driver. It was reported that salt reduces the water activity, and decreases the microbial proliferation. Also, salty taste enhances the bean flavor perception like that of meat, fish, which is an important factor in overall acceptability (Kindossi et al., 2013; Pietrasik and Gaudette, 2014). These correlations and the large range of sensory quality attributes, as well as the consumers' preferences will be helpful in upgrading the technology and improvement of the quality of toubani.

Conclusion

This investigation contributes to understanding on indigenous knowledge on toubani production and consumption. It shows that toubani is a ready to eat staple food produced from steam cooked cowpea used alone or in combination with yam. Toubani is commonly processed by the following unit operations: milling, kneading or whipping and cooking. Moreover, a large sensory quality attributes perceived by processors and

Table 4. Correlation coefficients between quality attributes of toubani.

Variables	Ashen colour	Brownish colour	Beany taste	Juiciness	Salty taste	Soft to the feel	Smooth texture	Springiness	Slightly hard	Mouth feel	Beany flavour	Very cook
Ashen colour	**1**											
Brownish colour	-0.696	**1**										
Beany taste	**0.920**	-0.468	**1**									
Juiciness	-0.310	0.715	-0.149	**1**								
Salty taste	-0.023	0.240	-0.053	**0.821**	**1**							
Soft to the feel	**-0.966**	0.615	**-0.974**	0.301	0.110	**1**						
Smooth texture	0.281	-0.680	-0.076	-0.745	-0.367	-0.109	**1**					
Springiness	-0.811	0.166	**-0.933**	-0.130	-0.117	**0.870**	0.257	**1**				
Slightly hard	**0.828**	-0.249	**0.863**	0.265	0.417	**-0.822**	-0.187	**-0.931**	**1**			
Mouth feel	-0.525	-0.187	-0.779	-0.367	-0.148	0.646	0.592	**0.919**	-0.794	**1**		
Beany flavour	0.570	0.106	0.759	0.526	0.459	-0.635	-0.577	**-0.897**	**0.904**	**-0.934**	**1**	
Very cook	-0.538	0.272	-0.495	0.566	0.649	0.529	-0.440	0.467	-0.246	0.309	-0.081	**1**

Coefficient in bold are significant to P<0.05.

consumers should be useful for standardizing the processing technique of toubani.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interest.

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