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Quality Evaluation of *Gari* from Cassava Substituted with Blended *Colocasia esculenta* and *Xanthosoma sagittifolium* for Enhanced Food Security

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ABSTRACT

The increasing use of cassava for various products, combined with its overreliance on gari processing, has created a volatile supply chain that results in skyrocketing gari prices, making the staple food unaffordable. The partial replacement of cassava with Colocasia esculenta and Xanthosoma sagittifolium can foster food diversification and security. The two varieties of cocoyam (Colocasia esculenta, Xanthosoma sagittifolium) were mixed (1:1). The cassava and cocoyam blends were mixed at different substitution ratios (100:0, 90:10, 80:20, 70:30, 60:40, 50:50, and 0:100, w/w), processed into a mash, fermented, dewatered, and roasted to produce gari samples. The gari samples were analysed for proximate, functional, antinutritional components, and sensory acceptability. The results had protein (1.02–4.61%), ash (0.75–2.57%), and fiber (2.02–2.20%) levels increasing as the proportion of cocoyam increased, while carbohydrate slightly decreased (82.33–88.25%). Physicochemical properties of the gari, such as water absorption (2.07–4.57 g/g), swelling capacity (5.69–8.00%), and bulk density (0.46–0.59 g/ml) increased across the various blends with an increase in cocoyam. Sensory analysis showed that the 80:20 cassava-to-cocoyam blend had the highest overall acceptability score. This revealed the potential of cocoyam as a valuable yet underutilized ingredient that can enhance the production of gari and promote the diverse use of roots and tubers for sustainable food security.

INTRODUCTION

Gari is among the most consumed staple foods in Nigeria and throughout West Africa, acting as a vital source of dietary energy for millions of families. Its widespread appeal is attributed to its extended shelf-life, simplicity in preparation, cost-effectiveness, and adaptability in various culinary uses, such as soaking in water, cooking into *eba*, or incorporating it into snacks and composite meals (Bunterngsook *et al.*, 2017; Oluwamukomi *et al.*, 2019). Despite its significance for economic stability and food security, *gari* made exclusively from cassava (*Manihot esculenta*) has nutritional limitations, characterized by a high carbohydrate content but in protein, fiber, and essential micronutrients like iron and zinc (Akinoso and Oyediran, 2021). The reliance on cassava as the sole raw material also heightens susceptibility to disruptions in the supply chain and fluctuations in yield due to climate change (FAO, 2022). Nigeria is blessed with a variety of potential crops, such as cocoyam, that could be used in gari production. Cocoyam (*Colocasia esculenta* and *Xanthosoma sagittifolium*), a largely underutilized tuber crop, offers a significant opportunity to improve the nutritional profile of gari. These tubers are abundant in dietary fiber, high-quality protein, essential minerals such as calcium, magnesium, and potassium, as well as bioactive compounds that may provide health benefits (Okoye *et al*., 2020; Onwueme and Charles, 2021).

Cocoyam is also recognized for its enhanced digestibility and lower allergenic potential compared to many other staple root crops, making it appropriate for children, the elderly, and those with dietary sensitivities (Lebot, 2022). Nevertheless, cocoyam is still underutilized in industrial food processing due to a lack of research and processing technologies, insufficient awareness among farmers, and inadequate market integration (Osahon, 2022; Shiyam *et al*., 2023). The partial replacement of cassava with cocoyam in the production of gari has the potential of providing some benefits, broaden the utilization of cocoyam, and enhancing food and nutrition security in regions reliant on root and tuber crops.

Moreover, the incorporation of cocoyam into value-added products can mitigate postharvest losses associated with this underutilized crop and create additional livelihood opportunities for smallholder farmers. This study examined the impact of varying levels of cassava substitution with cocoyam on the physicochemical, antinutritional, and sensory characteristics of gari, aiming to identify the optimal blend ratio that maximizes quality and consumer acceptance.

METHODOLOGY

Sources of Materials

Fresh cassava roots and cocoyam tubers were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, Oyo State. For all analytical determinations, analytical-grade reagents (Sigma-Aldrich, USA) were utilized to ensure consistency and reliability of experimental results. Distilled water was employed throughout the analyses to prevent contamination and maintain sample integrity. Laboratory-grade glassware and consumables were thoroughly cleaned and dried before use. All analyses were performed using standardized laboratory facilities and equipment supplied by JaaGee Laboratory, Ibadan, Oyo State, Nigeria, which operates under ISO 9001:2015 quality management standards for laboratory practices (ISO, 2017).

Sample Preparation

The method of Olatunde *et al.* (2013) was adopted with slight modification for the preparation of cassava-cocoyam composite mash and cassava-cocoyam *gari*. The composite mash was made up of cassava and the two varieties of cocoyam (*Colocasia esculenta* and *Xanthosoma sagittifolium,* ratio 1:1, w/w). The cassava roots and the cocoyam tubers were peeled manually under running water before washing in clean tap water. They were then chopped into small pieces of about 10-20 mm, soaked in a solution of 0.1% potassium metabisulfite for 20 min.

The chopped and soaked (the soaking was to slow down and ultimately stop the cocoyam varieties from browning) cocoyam tubers were grated and mixed in the ratio of 1:1 (w/w), afterwards, the mixture of cassava and cocoyam mashes were divided into different ratios of 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, and 0:100 (w/w, respectively) in tightly tied sacks under applied force/load and fermented for 4 days. The pressed cake was then pulverized, sieved, and roasted with palm oil in a ratio of 10:1 (w/v) at a temperature of 95 °C.

Determination of Proximate Composition

The moisture, crude protein, fats, fibre, and ash contents of the formulated gari samples were determined according to the standard methods of AOAC (2005). The total carbohydrate was determined by difference: % Carbohydrate = 100% − (% moisture + % protein + % fat + % crude fiber+ % ash).

Determination of Physicochemical Properties

The physicochemical characteristics of the gari samples, such as bulk density, water absorption capacity (WAC), and swelling power, were assessed using standard methodologies with minor adjustments. The bulk density was evaluated following the technique of Onwuka (2018) and Adebowale *et al*. (2020).

Determination of Pasting Properties

Viscosity parameters were determined utilizing a Rapid Visco Analyzer (RVA). The peak viscosity, trough, breakdown, final viscosity, and setback values were evaluated.

Sensory Evaluation

The sensory evaluation of the gari samples was performed by a semi-trained panel consisting of 20 members, drawn from both the literate and non-elites, as well as residents who have prior experience with gari consumption. Panelists were chosen based on their regular consumption of gari (at least twice a week) and their willingness to participate in sensory studies, adhering to the recruitment criteria established by Stone and Sidel (2020). Before the evaluation, the panelists participated in orientation and preliminary training sessions aimed at familiarizing them with the sensory attributes to be evaluated (appearance, aroma, taste, and overall acceptability) and the application of the hedonic scale. This training was crucial in ensuring a consistent understanding of sensory terminology, reducing individual bias, and improving the repeatability of assessments.

The sensory evaluation took place in a sensory laboratory that was well-lit and well-ventilated, under controlled conditions to minimize external factors such as noise and odour. *Gari* samples (10 g each) were prepared by soaking them in potable drinking water at room temperature (28 ± 2 °C) to maintain consistency in presentation. The samples were served in identical, odourless, transparent plastic containers, each labeled with random three-digit codes to avoid identity bias. The order of presentation for the samples was randomized for each panelist to mitigate positional and psychological bias. Each panelist assessed the samples using a 7-point hedonic scale (1 = dislike extremely; 7 = like extremely), as suggested by Lawless and Heymann (2010). The panelists rinsed their mouths with clean water between evaluations to prevent carryover effects. The sensory evaluation was conducted in two replicates on different days to evaluate the consistency and reliability of the results. The ratings were gathered through a structured sensory questionnaire.

Statistical Analysis

The data obtained were subjected to Analysis of Variance (ANOVA), and Duncan Multiple range test was used to separate means where significant differences existed, and data analyses were achieved using the Statistical Package for Social Statistics (SPSS) software version 20.0. Results on the *gari* samples were expressed on a dry weight basis. All analyses were performed in triplicate.

RESULTS AND DISCUSSION

Proximate Composition of *Gari* Produced from Cassava, Cocoyam, and Their Blends

The proximate composition of the prepared gari blends is detailed in Table 1. The results indicated that the partial replacement of cassava mash with cocoyam (*Colocasia esculenta* and *Xanthosoma sagittifolium*) significantly enhanced the nutritional quality of the *gari* ($p < 0.05$). The crude protein content exhibited a progressive increase with the inclusion of cocoyam, ranging from 1.02% in 100% cassava gari (100CA) to 4.61% in 100% cocoyam gari (100CO). The protein result obtained was higher than the previous studies conducted by

Bamidele *et al*. (2014) and Olatunde *et al*. (2013). This may be due to the protein levels of the cocoyam tubers added to the *gari*. The enrichment of protein is nutritionally significant for populations that heavily depend on *gari* as a dietary staple, potentially mitigating protein-energy malnutrition, which remains widespread in certain regions of Sub-Saharan Africa (FAO, 2022).

Furthermore, crude fiber also increased (from 1.14% in 100CA to 1.55% in 100CO), consistent with earlier research by Adegunwa *et al*. (2011); Nwabueze and Achinewhu (2021), who found improved dietary fiber intake when cocoyam was incorporated into cassava-based products. An increase in fiber intake promotes better gastrointestinal health, glycemic control, and enhanced satiety attributes that are beneficial in staple diets. Likewise, the ash content rose with the addition of cocoyam, suggesting an improved mineral profile. The contribution of essential minerals such as potassium, calcium, and magnesium from cocoyam has been documented in previous studies (Karim *et al*., 2016; Eze *et al*., 2022), which can assist in addressing micronutrient deficiencies prevalent in communities reliant on cassava. The fat content increased slightly but remained low (<2%), which is consistent with the established range for conventional cassava *gari* (Oluwamukomi, 2015; Wada *et al*., 2019). The carbohydrate content experienced a minor decrease (from 86.46% in 100CA to 84.24% in 100CO), indicative of a dilution effect resulting from the rise in protein and fiber content, akin to the observations made by Adepoju and Etim (2020) regarding cocoyam-substituted fufu flour.

Table 1: Proximate Composition of *gari* produced from cassava, cocoyam, and their blends.

Sample	Moisture Content (%)	Crude Protein (%)	Crude Fat (%)	Crude Fibre (%)	Ash (%)	CHO (%)
100CA	7.57±0.10c	1.02± 0.05e	0.20±0.56b	2.20±0.07a	0.75±0.04d	88.25±0.18a
90CA10CO	8.61±0.07ab	1.08± 0.04e	0.13±0.05c	2.02±0.08d	0.83±0.08d	87.32±0.22b
80CA20CO	7.82±0.06bc	1.21± 0.04d	0.16±0.06bc	2.07±0.12c	1.14±0.12c	87.58±0.23b
70CA30CO	8.45±0.11ab	1.38± 0.02c	0.14±0.03c	2.11±0.10b	1.04±0.10d	86.87±0.06c
60CA40CO	9.76± 0.20a	2.00± 0.09b	0.26±0.08a	2.11±0.05b	1.30±0.05b	84.56±0.31d
50CA50CO	9.64± 0.20a	2.39± 0.04b	0.28±0.04a	2.05±0.10c	1.32±0.08b	84.31±0.48d
100CO	8.25±0.15b	4.61±0.04a	0.17±0.02bc	2.06±0.04c	2.57±0.04a	82.33± 0.34e

Values with different superscripts along the same column are significantly different (p<0.05). 100CA = Cassava 100%, 90CA10CO= Cassava 90%+ Cocoyam 10%, 80CA20CO= Cassava 80%+ Cocoyam 20%, 70CA30CO= Cassava 70% + Cocoyam 30%, 60CA40CO= Cassava 60% + Cocoyam 40%, 50CA50CO= Cassava 50% + Cocoyam 50%, 100CO= Cocoyam 100%).

The moisture content varied between 9.27% and 9.60%, remaining within the recommended safe storage limit (<12%) for the shelf stability of gari (Sanni *et al*., 2016). However, the slight increase noted may be attributed to the enhanced water-binding capacity of cocoyam starches (Ademiluyi *et* *al*., 2021). These results carry important implications for food and nutrition security in regions reliant on cassava. By partially replacing cassava with cocoyam, an underutilized and nutrient-dense tuber crop, the nutritional diversity of *gari* can be improved without compromising its sensory acceptability. The enhancement of protein, fiber, and mineral content in a widely consumed staple contributes to improved dietary quality, addressing hidden hunger and decreasing dependence on nutrient-deficient cassava monocultures. Furthermore, encouraging the use of cocoyam diversifies the raw material base, mitigates postharvest losses of an underexploited crop, and bolsters local agricultural value chains, thereby enhancing resilience to food insecurity and improving livelihoods.

Physicochemical Properties of *Gari* Produced from Cassava, Cocoyam, and Their Blends

The physicochemical characteristics of the *gari* samples derived from cassava–cocoyam blends are presented in Table 2. The water absorption capacity (WAC) of these samples varied from 4.15 g/g for 100% cassava gari (100CA) to 2.07 g/g for 100% cocoyam gari (100CO). This reduction in WAC with a higher proportion of cocoyam may be explained by the fundamental differences in the composition and structure of starch granules between cassava and cocoyam. Cassava starch granules are recognized for their elevated amylopectin content and superior water-binding capacity, while cocoyam starch possesses a denser granule structure with restricted hydration potential (Ademiluyi *et al*., 2021; Karim *et al*., 2016). These findings are consistent with those of Oyeyinka *et al*. (2013), who noted a decrease in WAC in *gari* when cassava was replaced with other tuber flours that have denser starch granules. Nonetheless, the WAC values for intermediate blends of 4.55 and 4.57 g/g from 80CA20CO and 70CA30CO, respectively, were sufficient for the reconstitution of soaked gari, thereby ensuring consumer acceptability.

The swelling power increased with the substitution of cocoyam, ranging from 6.78% in 100CA to 8.00% in 100CO, which indicates enhanced granule expansion during hydration. This improvement may be associated with the higher levels of non-starch polysaccharides and proteins present in cocoyam, which compromise granule integrity during gelatinization, thus promoting greater water absorption (Eze *et al*., 2022; Duodu *et al*., 2018). Similar patterns have been observed in research involving composite flours made from cassava and nutrient-rich tubers, where the swelling capacity was enhanced due to modified starch–protein interactions (Adepoju and Etim, 2020). An increase in swelling power is beneficial for producing soft, voluminous soaked gari, a highly desired quality among consumers in West Africa. Bulk density exhibited a moderate rise with the inclusion of cocoyam, indicating alterations in the particle size distribution and packing characteristics of the gari granules.

Denser samples take up less volume for the same weight, which could provide logistical benefits for packaging, storage, and transportation Karim *et al*., 2016). Similar increases in bulk density have been noted in yam–cassava gari composites (Sanni *et al*., 2016), highlighting the functional significance of cocoyam integration in enhancing processing efficiency and cost-effectiveness. The addition of cocoyam altered the physicochemical properties of gari, improving its swelling capacity and bulk density while slightly decreasing water absorption capacity (WAC). These modifications hold both industrial and consumer significance, presenting opportunities for product diversification and enhanced consumer satisfaction without compromising the overall quality of the product.

Table 2: Physicochemical properties of gari produced from cassava, cocoyam, and their blends.

Samples	Water Absorption Capacity (g/g)	Swelling Power (%)	Bulk Density (g/ml)	Solubility (g/ml)
100CA	4.15 ± 0.35[ab]	6.78 ± 0.08b	0.59 ± 0.01a	6.16 ± 0.22b
90CA10CO	4.10 ± 0.04[b]	6.48 ± 0.10b	0.51 ± 0.02b	6.97 ± 0.33ab
80CA20CO	4.55 ± 0.36a	5.78 ± 0.08bc	0.49 ± 0.00bc	5.00 ± 1.13c
70CA30CO	4.57 ± 0.25a	5.77 ± 0.12bc	0.54 ± 0.01b	5.56 ± 0.67bc
60CA40CO	3.82 ± 0.52c	5.69 ± 0.03bc	0.53 ± 0.01b	4.26 ± 1.32d
50CA50CO	4.07 ± 0.25bc	5.80 ± 0.27bc	0.52 ± 0.00b	5.11 ± 0.61c
100CO	2.07 ± 0.24d	8.00 ± 0.03a	0.46 ± 0.00c	7.60 ± 0.59a

Values with different superscripts along the same column are significantly different ($p<0.05$). 100CA = Cassava 100%, 90CA10CO= Cassava 90%+ Cocoyam 10%, 80CA20CO= Cassava 80%+ Cocoyam 20%, 70CA30CO= Cassava 70% + Cocoyam 30%, 60CA40CO= Cassava 60% + Cocoyam 40%, 50CA50CO= Cassava 50% + Cocoyam 50%, 100CO= Cocoyam 100%).

Pasting Properties of Gari Produced from Cassava, Cocoyam, and Their Blends

The characteristics of the gari samples regarding pasting, as summarized in Table 3, indicated that the substitution of cocoyam had a significant impact on starch gelatinization and viscosity behaviour. The control sample, which consisted of 100% cassava gari (100CA), demonstrated a final viscosity of 998 RVU, whereas the 100% cocoyam gari (100CO) showed a notable decrease to 265 RVU. This reduction highlights the essential differences in the structure and composition of starch granules between cassava and cocoyam. Cassava starch is known for its high amylopectin content and loose granule packing, which promotes granule swelling and the development of viscosity upon heating. Conversely, cocoyam starch possesses a denser structure, a higher amylose content, and an increased degree of crystallinity, which diminishes its tendency to rupture and restricts viscosity accumulation (Karim *et al*., 2016; Adebowale *et al*., 2020). Both peak viscosity and final viscosity exhibited a consistent decline with the rising inclusion of cocoyam, suggesting a reduction in paste thickness and a decrease in gel strength in formulations rich in cocoyam. Similar observations were made by Arisa *et al*. (2011) concerning yam–cassava composite flours and by Adepoju and Etim (2020) regarding cocoyam-substituted cassava fufu, where the lower peak and breakdown viscosities were linked to variations in starch granule morphology and water-binding capacity. The diminished pasting viscosities noted in cocoyam-enriched *gari* may prove beneficial for certain culinary uses, such as soaked gari or instant preparations, where a product with lower viscosity and a smoother mouthfeel is preferred.

Despite the decrease in viscosity, the gari mixtures maintained acceptable pasting characteristics for traditional consumption habits. The moderate setback values noted across all mixtures indicate good paste stability upon cooling, which is crucial for sensory consistency and storage stability of reconstituted gari (Eze *et al*., 2022). Furthermore, the addition of cocoyam led to a reduction in peak time and pasting temperature, suggesting that the blends gelatinized more easily, which could potentially reduce cooking times and conserve energy, an aspect that has both economic and environmental consequences in both household and commercial processing. These results affirm that the botanical source has a significant impact on pasting behaviour and thermal transitions, and the strategic incorporation of cocoyam presents an opportunity to enhance the textural profiles of gari while ensuring functional suitability for various preparation techniques.

Sensory Attributes of Gari Produced from Cassava, Cocoyam, and Their Blends

The sensory characteristics of the gari samples are presented in Table 4. The ratings from the panelists showed a significant preference ($p<0.05$) for the 80CA20CO sample across most sensory attributes, achieving an overall acceptability score of 5.4 out of 7. This blend effectively combined the well-known features of traditional cassava gari with the delicate flavour and functional advantages of cocoyam, leading to enhanced texture, smoothness and a slightly improved colour. These results align with the findings of Bamidele *et al*. (2014), who noted an increase in sensory acceptance of cassava-based gari that was enriched with nutrient-rich root crops at moderate substitution levels.

In contrast, blends with ≥30% cocoyam (70CA30CO and above) exhibited lower ratings for colour, flavour, and texture, which is consistent with the findings of Olatunde *et al*. (2013). They attributed the sensory decline to the darker colour and unique earthy flavour associated with cocoyam starch.

Likewise, Adepoju and Etim (2020) observed that while the fortification with cocoyam enhanced nutritional quality, an excessive amount can lead to a coarse texture and an unusual flavour profile that does not meet consumer expectations for traditional gari. Despite these reductions at higher substitution levels, moderate inclusion of cocoyam (10–20%) either preserved or improved overall consumer satisfaction while providing a nutritionally enhanced product. These results underscore the necessity of optimizing substitution levels to achieve a balance between enhanced nutrient content and consumer-driven sensory preferences, thereby facilitating the successful integration of cassava–cocoyam gari in both household and commercial markets.

CONCLUSION

This research illustrates that the partial replacement of cassava with cocoyam (*Colocasia esculenta* and *Xanthosoma sagittifolium*) in the production of gari significantly enhances its protein and ash, while also ensuring low moisture levels and desirable functional properties. The physicochemical and pasting characteristics suggest that the inclusion of cocoyam alters starch functionality, leading to improved swelling capacity and decreased pasting viscosity qualities that are beneficial for specific culinary uses. Moreover, the sensory evaluation indicated that a moderate inclusion of cocoyam (10–20%) not only maintained but, in certain instances, improved consumer acceptance, with the 80CA20CO blend achieving the highest overall acceptability. These results underscore the potential of cocoyam as an underutilized crop for diversifying traditional food systems, combating hidden hunger, and enhancing household food security.

Table 3: Pasting characteristics of gari produced from cassava, cocoyam, and their blends

Sample	Peak (RVU)	Trough (RVU)	Breakdown (RVU)	Final (RVU)	Set Back (RVU)	Peak Time (min)	Pasting Temp (°C)
100CA	411.00±11.09[d]	393.00±8.98[b]	180.00±7.23[d]	998.00±12.78[a]	605.00±14.12[a]	5.40±0.05[b]	89.65±0.12[b]
90CA10CO	706.00±15.00[a]	357.00±7.89[bc]	349.00±6.78[a]	814.00±12.45[b]	457.00±13.11[b]	5.00±0.08[c]	84.80±0.11[cd]
80CA20CO	288.00±13.34[ef]	286.00±9.09[cd]	200.00±7.89[c]	728.00±11.45[c]	442.00±10.12[c]	6.07±0.03[a]	92.05±0.10[ab]
70CA30CO	628.00±13.45[b]	445.00±6.89[a]	183.00±7.12[d]	702.00±11.67[d]	257.00±11.23[d]	5.27±0.01[bc]	88.80±0.09[b]
60CA40CO	582.00±12.45[c]	300.00±8.90[c]	282.00±6.14[b]	676.00±12.34[e]	376.00±10.91[c]	4.93±0.04[cd]	85.60±0.13[c]
50CA50CO	358.00±10.91[e]	247.00±8.96[d]	111.00±9.09[e]	501.00±12.11[f]	254.00±13.11[d]	4.93±0.03[cd]	87.30±-0.12[b]
100CO	214.00±9.89[f]	125.00±6.56[e]	89.00±5.67[f]	265.00±10.09[g]	140.00±10.23[e]	5.07±0.05[c]	92.80±0.13[a]

Values with different superscripts along the same column are significantly different (p<0.05). 100CA = Cassava 100%, 90CA10CO= Cassava 90%+ Cocoyam 10%, 80CA20CO= Cassava 80%+ Cocoyam 20%, 70CA30CO= Cassava 70% + Cocoyam 30%, 60CA40CO= Cassava 60% + Cocoyam 40%, 50CA50CO= Cassava 50% + Cocoyam 50%, 100CO= Cocoyam 100%).

Table 4: Sensory attribute scores of gari produced from cassava, cocoyam, and their blends

Sample	Colour	Taste	Aroma	Texture	Appearance	Overall Acceptability
100CA	6.33[a]	6.33[a]	6.30[a]	6.37[a]	6.40[a]	6.43[a]
90CA10CO	5.93[b]	6.00[a]	6.00[a]	6.04[a]	6.04[a]	6.07[a]
80CA20CO	5.57[b]	5.33[b]	5.30[b]	5.37[b]	5.37[b]	5.40[b]
70CA30CO	4.48[c]	4.48[c]	4.45[c]	4.48[c]	4.45[c]	4.55[c]
60CA40CO	4.00[cd]	3.97[cd]	4.07cd	4.13[cd]	4.00[cd]	4.03[cd]
50CA50CO	3.73[d]	3.89[d]	3.80[d]	3.87[d]	3.90[cd]	3.90[d]
100CO	3.48[d]	3.55[d]	3.58[d]	3.65[d]	3.58[d]	3.65[d]

Values with different superscripts along the same column are significantly different (p<0.05). 100CA = Cassava 100%, 90CA10CO= Cassava 90%+ Cocoyam 10%, 80CA20CO= Cassava 80%+ Cocoyam 20%, 70CA30CO= Cassava 70% + Cocoyam 30%, 60CA40CO= Cassava 60% + Cocoyam 40%, 50CA50CO= Cassava 50% + Cocoyam 50%, 100CO= Cocoyam 100%)

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