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Proximate, mineral and sensory properties of Hambusgers produced from beef and cashew apple pomace

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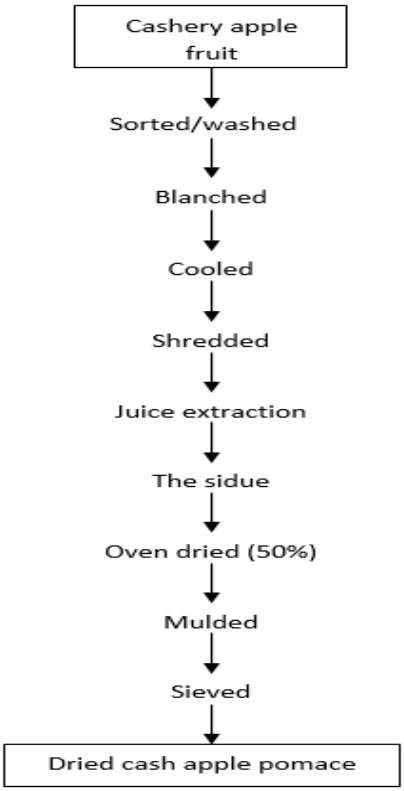
Abstract
This research was conducted to evaluate the nutrients and sensory properties of hamburgers produced from beef and cashew apple pomace. Five burger samples were prepared with different combinations (10%, 10%, 20%, 30%, ad 40%) of cashew apple pomace. The proximate composition of burgers without (10%) cashew apple pomance differed significantly (P<0.05) from burgers with cashew apple pomace. Moisture content of the cashew-beef burgers ranged from 42.98 – 45.26%, Ash 1.34 – 2.55%, fat 19.11 – 21.06%, protein 15.82 – 33.87%, crude fiber 3.38 – 7.41% and carbohydrate 4.93 – 13.67%, significant different (P<0.05) in the mineral element (Magnesium, iron, copper, zinc and calcium) content were observed between burgers without (0%) cashew apple pomace and burgers with cashew apple pomace. Calcium content ranged from 0.04 – 0.07mg/100g, zinc 43.43 –51.23mg/100g, potassium 0.35 – 0.45mg/100g, copper 2.52 – 4.10mg/100g and magnesium 0.05 – 0.06mg/100g. The change in the magnesium content of all the burger samples did not show any significant difference (P>0.05). Burgers without cashew apple pomace differed significantly (P<0.05) from those with cashew apple pomace in their vitamin, calcium, zinc and copper except for hamburger substituted with 10% cashew apple pomace. The addition of upto 10% of the residue did not cause significant (P<0.05) sensory changes in the flavor, texture juiciness, chewiness, colour, and taste of the samples. However, the addition of cashew apple pomace being a by-product of cashew nuts will also increase economic outlay of the cashew plant.

Keywords: Hamburger patties, cashew apple, sensory evaluation, juiciness

Introduction
Meat and meat products are among the most important protein sources in the daily diet of people living in developed countries. Hamburger is the round cake of minced beef, dried or grilled and specially served in a bread roll gernished with various condiments. A regular hamburger consists of 70-80% beef and 20-30% fat. It is a meat product that traditionally contains 2.2 – 2.4% salt (Feiner, 2006) [1]. Other substances aside beef and fat could be added to improve on the nutritive value, but and sensory properties of hamburger (Adebowafl *et al*., 2011). Most of the European countries regulated that burgers should contain at least 80% meat and 20-30% fat content (Al-mrezeeg, *et al*., 2008.
In Malaysia, the government has set a minimum requirement of meat content in manufacturing of any process meats including burgers, to be not less than 65% (Food Act, 1983 and Food regulations, 1985).
Cashew consist mainly the nuts constraining an Embryo and a false fruit commonly called cashew kernel/nut and cashew apply respectively (Aduru cashew kernel constituee 20-25% of the nut. Cashew pomace is considered as waste in many countries. It is a common product in Nigeria. At its peak the apply waste away due to lack of processing industry and low interest resulting from ignorance of its potentials in the food industry. When boiled or dried, it is brown in clour. In soup and stew, cashew appy pomace shows the colour and texture of red meat. The yellow variety of cashew apple pomace has up to 11.78% protein. The sun dried cashew apple promace (red/yellow) had been reported to contain 88.34 to 88.89% dry matter, 11.
11 to 11.66% moisture, 3.32 to 5.33% ash and 6.85 to 11.78% protein (Aduku, *et al*, 2010) [3].
Many efforts have been made to improve the quality and stability of burgers because consumer demand for health fast food has rapidly increased in recent years (papodina and Bloukas, 1999). Currently, new food products are prepared to satisfy customers demand concerning taste, appearance and quality. Hamburgers are highly consumed around the world, despite being considered as a high caloric value food, hamburgers can be produced with good quality raw materials such as cashew apple pomace, since it offers good source of nutrients thereby enriching the hamburgers with some ingredients that could offer some nutritional properties.

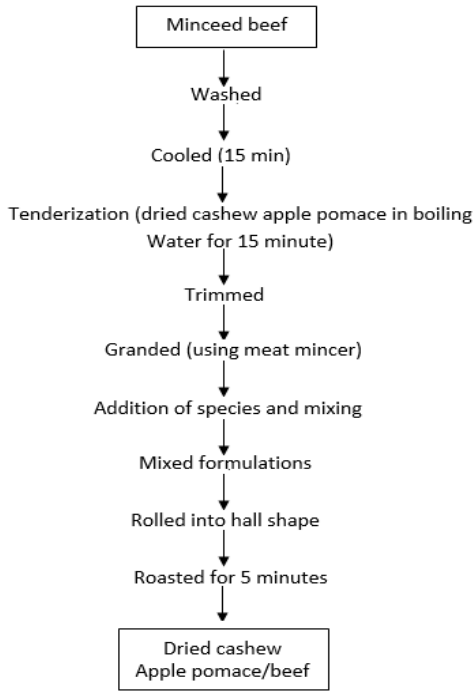
Material and Methods
Material procurement
The fresh cashew apple fruits, iodized salt, fresh meat (beef), margarine, garlic, cabbage, fresh tomatoes, onions, gingers and black pepper were purchased from mile 3 market, Port Harcourt in Rivers State, Nigeria.
Preparation of the cashew Apple Pomace
The method described by Aduku, *et al*., (2010) [3] was adopted. The freshly harvested casher's apples were sorted, runsed in clean water and blanched at 85^0C for 15 minutes and allowed the cool for 45 minutes. The blanched content was shredded and the juice extracted. The residue was oven dried at 50^0C to constant moisture content. The dried product was packaged in polyethene container until use.



***Source*:** (Aduku *et al*., 2010)

Fig 1: Flow chart for preparation of dried apple pomace production

Production of dried cashew apple/beef hamburger fresh meat (beef) of 500kg was washed, trimmed and minced using electrically powered meat grinder. Equal weight of spices (papper, ginger, salt and onions) was added and cooked for 15 minute. The dried cashew apple pomace was tenderized in boiling water for 15 minutes. The formulation was for properly mixed rolled in ball shaped, roasted for 5 minutes.



***Source*:** (Aduku *et al*., 2010)

Fig 1: Flow chart for preparation of dried apple pomace production

Table 1 shows the recepy formation of the dried cashew apple pomace/beef burger.

Table 1: Recepy for the formulation of dried cashew apple pomace/beef burgar

Ingredient	A	B	C	D	E
Beef	80	70	60	50	40
Fat	20	20	20	20	20
Dried cashow apple pomace	-	10	20	30	40
Iodized salt (g)	5.0	5.0	5.0	5.0	5.0
Finely diced onions (g)	10	10	10	10	10
Fresh Tomatoes (g)	10	10	10	10	10
Cabbage (g)	10	10	10	10	10
Ginger (g)	0.2	0.2	0.2	0.2	0.2
Garlic (g)	0.2	0.2	0.2	0.2	0.2
Black pepper (g)	0.2	0.2	0.2	0.2	0.2

***Source*:** (Aduku, *et al*, 2010) [3]

Coded samples of hamburgers were served to twenty panel of judges who are familiar with hamburger food. The judges were presented with water for mouth rising after each tasting and they were asked to score the sample for colour, juiciness, texture aroma, chewiness, taste and overall acceptability, using a 9-point hedonic scale where 9 = like extremely, to 1 = dislke extremely (Iwe, 2002) [5].

Proximate analysis

Moisture determination

Moisture contents determination (AOAC, 2012) [6], the moisture cans were dried for 15 minutes at 105^0C. It was allowed to cool in the desicator for 20 minutes and the weight was taken. Two (2g) of the cashew apple/beef burger samples were weighted and transferred into each crucible and weight of the curable with sample taken. The crucible with sample were then placed in the oven at 105^0C and allowed to dry for 2 house after which the sampled was removed and allowed to cool in the desicator for 20 minutes. The crucible with sample were recorded. The moisture contents of the samples were then calculated using the formular below:

$$\% \text{ moisture content} = \frac{\text{moisutre loss}}{\text{sample weight}} \text{ x } \frac{100}{1}$$

Moisture loss = (curable weight + sample before drying = crucible weight + sample after drying

Sample weight = (crucible weight + sample before drying = crucible weight

Ash determination

Ash content determination was done according to the method of AOAC (2012) [6]. The crucibles were thoroughly washed, cleaned and placed in over to dry for 30 minutes. They were cooled in the desicator for 20 minute and the weight taken. Two (2.0g) of the dried cashew apple pomace/beef burgle samples were weighted into the crucibles after which they were taken to the furnacne for ashing at 550^0C for 2 hours. The samples were removed and allowed to cool to room temperature in the desicator and the weight recorded, as follows:-

$$\% \text{ Ash} = \frac{\text{Wesight of ash}}{\text{sample weight}} \; x \; \frac{100}{1}$$

Ash = weight of crucible after drying – weight of empty crucible
Sample weight = weight of crucible + sample – sample – weight of empty crucible.

Determination of Crude Protein Content
The crude protein composition was determined following the method of AOAC (2017) [6]. The sample (2.0g) was weighted and transferred into a digestion flast. And 0.3g of catalyst (copper sulphate) was weighted into the flask. Three (3.0g) of sodium sulphate was also weighted into the flask. Twelve of concentrated H_2So_4 was added to the flask. The flask was transferred to the digestion rack and take to the fume cupboard and also heted for a minimum of 1hr of 300^0C – 470^0C. When a clean soloution was formed, water was added and poured into a flat bottom flask. The solution was made up to 100ml. About 10 ml of 2% boric acid was measured into 100ml conical flast (as receiving flask). Twenty (20) ml of the digest was transferred into a icjedahl flask and 20ml of 45% NaoH added. Steam was passed into the digest and collected into the boric acid indicatoir until sets to the 50ml marbance 0.05N H_2SO_4 was poured into the bure the and titrated against the condensed sample plus an indicator until it slightly turns pink. The reading was taken as the final titre and the percentage Nitrogen and crude protein were calculated as follows:

$$\% \text{ Nitrogen} = \frac{\text{sample titre - blank titre x mormality of acid x 1.1}}{\text{sample weight}}$$

Protein content = % Nitrogen x Protein factor (6.25)

Determination of fat content of the sample
The fact content of the sample was determined following the procedure of AOAC (2012) [6]. A clean dried 500ml round bottom flask was weighed (W_1) and 300ml of petroleum either (40 -60^0C) for the extraction was poured into the flask fitted with soxhlet extraction unit. The extractor thimble containing 2.0g of the samples was fixed into the soxhlet extraction unit. A round bottom flask and a condenser was connected to the soxhlet extractors and cold water circulation put on. The heating mantle was switched on and the heating rate adjusted until the solvent is refluxing at a steady rate. Extraction was carried out for six hours, the round bottom flask and oil were cooled then weight (w_2). The lipid content was calculated thus:

$$\% \text{ crude lipid content} = \frac{W_2 - W_1}{\text{sample weight}} \; x \; \frac{100}{1}$$

Determination of Crude Fiber
The crude fiber content of the sample was determined following the AOAC (2012) [6]. The defalted sample was placed in a beaker and 25ml of1.25% H_2So_4 were added to the sample. The mixture was then heated and allowed to boil for 4-5 minutes in a heating mantle and the beaker covered with awash glass. A funnel with filter paper was used to filter the boiled sample using boiling water to rinse the remains in the beaker. This process was continued until the sample washing was free from acid, and 25ml of NaoH was measured and used to wash the residue back into a beaker and brought to boil. It was then boiled for 4-5 minutes and the allowed to stand for 1 minutes. The sample was filtered through an ashless filter paper that has been dried and weighed. It was washed thoroughly using boiling water until the content was free from the base. The filter paper was transferred to the oven and allowed to dry for 1 hour at 105^0C after which they were cooled and weighed. The filelr papers were transferred to an already dried and weighed crucible and then ashed for 2 hours at 550^0. The weights were taken and the results calculated as follows:

$$\% \text{ fiber} = \frac{\text{Crude fiber}}{\text{sample weight}} \; x \; \frac{100}{1}$$

Determination of carbohydrate
The carbohydrate was determined by the calculation of carbohydrate = 100 – (protein + moisture + fat + fiber tashed

Mineral analysis
Determination of magnesium
Ten of the solution was pipette into 250ml conical flask. Then 35ml of ammonia – ammonium chloride (NH_3-NH_4Cl) buffer, 25ml of water and 2 to 3 drops of erinchrome Black – T indicator was added respectively to the test solution. This was titrated against 0.01 NEDTA solution. The volume of EDTA used was the volume equivalent of magnesium in the admixture

$$\% \text{ magnesium} = \frac{\text{Vol.EDTA x MOLEDTA x AT x W x MG x}}{\text{1000 x sample weight}} \; x \; \frac{100}{1}$$

Determination of Calcium
Ten ml of the test solution was pipette into 250ml council fask. Then25ml of potassium hydroxide, 25ml of water, and a pinch of calcium indicator were added to the test solution. It was titrated against 0.01 NEDTA solution to an end point. The volume EDTA was the volume equivalent of calcium in solution.

$$\% \text{ Calcium} = \frac{\text{Vol. EDTA x MOl. EDTA x At. x Wt.mg x 100 x DF}}{\text{1000 x sample weight}}$$

Determination of Potassium
Potassium was determined using a flame photometer (Gallenkamp Flame Analyzer). Potassium and sodium standards were prepared. The standard solutions were used to calibrate the instrument read out. The meter reading was set at 100% E (emission) to aspire the top concentration of the standards.
The % E of the intermediate standard curves was plotted on linear graph paper with these reading. The sample solution was aspired on the instruments, and the readings (% E) were recorded. The concentration of the element in the sample solution was read from the standard curve.

$$\% \text{ potassium} = \frac{\text{PPm x100 x DF}}{\text{1 million}}$$

Statistical analysis
Analyses were done in triplicate. All values obtained were subjected to analysis of variance (ANOVA) using Microsoft excel spreadsheet, (2013) version) and the differences in

mean significance using LSD which were defined at (P < 0.5).

Results

Table 2 shows the proximate composition of hamburgers produced from beef and cashew apple pomace. Moisture content of the hamburgers ranged from 42.98 to 45.26%, with sample a recording the highest and samples D and E the lowest. Ash conent of the hamburgers ranged from 1.35 to 2.55% with sample E recording the lowest and sample A, the highest. The fat contents of the hamburgers ranged from 19.11 to 21.06% with sample E recording the lowest and sample A the highest. Protein content of the hamburgers produced ranged from 15.81 to 22.87% with sample A recording the highest and sample E the lowest. Crude fiber conent of the hamburgers ranged from 7.41 to 3.38% with sample E recording the highest and sample A, the lowest carbohydrate content of the prepared hamburgers ranged from 4.93 to 13.67% with sample E recording the highest and sample A, the lowest.

Table 2: Proximate composition of Beef Bugger cashow apple

Samples	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Crude fiber	CHO %
A	45.26±23^{a}	2.55+ 0.07^{a}	21.06±0.01^{a}	22.87±1.28^{a}	3.38±0.22^{C}	4.93±1.39^{C}
B	44.56±1.99^{a}	2.55±0.07^{a}	20.68±0.00^{a}	17.99±1.23$_{b}$	3.61±0.07^{C}	10.92±0.76^{b}
C	43.55±1.33^{a}	2.00±0.00^{c}	20.80±0.18^{a}	16.84±0.00^{b}	4.09±0.06^{C}	12.73±1.64^{a}
D	42.98±0.17^{a}	2.00±0.00^{d}	20.30±0.21^{b}	16.71±0.62^{b}	4.43±012^{b}	13.58±0.45^{a}
E	42.98±0.00^{a}	1.34±0.06^{a}	19.11±0.27^{b}	16.81±0.62^{b}	7.41±0.6^{a}	13.67±0.37^{a}
LSD 2.67		0.11	1.13	2.22	0.38	3.08

Result are expressed as means ± S.D; n = 2 values in the same column having different superscript are significant different at P < 0.05

Kufes: A = 100% Beef barger; B = 90% Beef; 10% casher apple

C = 80% Beef: 20% Cashew apple pmance

D = 70% Beef: 20% cashew apple pomance

70% Beef, 30% cashew apple pomace

= 60% Beef, 40% cashew apple pomance

Table 3, shows the mineral composition of hamburgers produced from beef and cashwer apple pomace. The calcain content of the hamburgers ranged form 0.04 – 0.7/100g with sample D and E recording the lowest in both cases sample A. The highest zinc content of hamburger ranged from 43.46 – 51.23ng /100g with sample a recording the highest with samples E the lowest.

The potassium content of the hamburgers produced ranged from 0.35 – 0.45mg/100g with sample A recording the highest and sample E, the lowest coppers contain of the humbugs ranged from 2.5 2-4.10mg /100g with sample A recording the highest and sample E, the lowest the magnessum content of the hamburgers ranged from 0.05 – 0.06mg/100g with sample E recording the lowest.

Table 3: Mineral composition (mg/100g) the Hamburgers of beef/casher apply

Samples	Ca	Zn	K	Cu	Mg
A	0.07±00^{a}	51.23±0.39^{a}	0.45±0.00^{a}	4.10±0.07^{a}	0.06±0.00^{a}
B	0.06±0.00^{a}	50.66±0.63^{a}	0.42±0.01^{ab}	4.00±0.02^{ab}	0.06±00^{a}
C	0.04±0.00^{b}	45.80±0.33^{b}	0.44±0.00^{a}	3.80±0.14^{b}	0.06±0.00^{a}
D	0.04±0.00^{b}	46.53±0.46^{b}	0.41±0.00^{b}	2.74±0.14^{b}	0.06±0.00^{a}
E	0.04±0.00^{b}	43.43±0.46^{c}	0.35±0.0^{b}	2.52±0.06^{d}	0.05±0.00^{b}
LSD 0.01		0.11	1.13	2.22	0.38

Result are expressed as mean ± SD, n= 2, values in the same column having different superscript are significantly different at P < 0.05.

Keys: A = 100% beef hamburger;

B = 90% beef; 10% cashew apple pomace

C= 80% beef, 20% cashew apple pomance

D = 70% beef, 30% cashew apple pomance

E = 50^ beef, 40% cashew apple pomace

The mean sensory scores of cashew apple pomace (beef burger is presented in Table 4: The colour of the hamburgers produced ranged from 7.00 to 8.00 with sample A, the most preferred and sample D, the least preferred texture and taste of the hamburgers ranged from 7.15 to 8.10 and 7.10 to 8.10 respectively with sample A as most preferred and sample E least preferred. The rest of the result is shown in table 3.

Table 4: Mean sensory scores of cashew apple/beef burger

Sample	Colour	Texture	Task	Flavor	Juiciness	Chewiness	Overall accept obility
A	8.00[a]	8.10[a]	8.10[a]	8.10[a]	8.20[a]	8.00[a]	8.10[a]
B	7.05[a]	7.15[a]	7.25[a]	7.20[a]	7.05[a]	7.05[a]	7.80[a]
C	7.00[a]	7.30[a]	7.50[a]	7.35[a]	7.05[a]	7.00[a]	7.50[a]
D	6.95[a]	7.30[a]	7.10[a]	7.45[a]	6.85[a]	6.95[a]	7.10[a]
E	7.00[a]	7.15[a]	7.00[a]	6.95[a]	6.50[a]	7.00[a]	7.25[a]
LSD	1.90	1.94	2.18	2.22	2.81	2.24	2.17

Values in the same column having the same superscript are significantly different at $P < 0.05$

Keys:

A = 100% beef burgar

B = 90% beef: 100% cashew apple pomace

C = 80% beef: 20% cashew apple pomace

D = 70% beef: 30% cashew apple pomace

E = 60% beef: 40% cashew apple pomace

Discussion

The proximate composition of hamburger samples revealed that there was a decrease in the moisture content from 45.26 -42.98% as the substitution level of cashew apple pomace increased. At all levels of cashew apple pomace substitution. Moisture content of the hamburgers were not significantly different ($P > 0.05$) from one another these results are similar to the findings of michode-ehoun-mesress *et al* (2008) hamburgers mixed with different amounts of oat fibers. Olonta (2012) [9] also reported a decrease in the moisture content off hamburgers as the level of substitution of mushroom increased from 54.40 to 47.85% moisture content is also an index of water activity and is used as a measure of the stability and susceptibility to microbial contamination. The high moisture content in the hamburgers produced from 100% beef showed that it would have a shorter shelf life (Okerulu *et al et al* 2015) [10].

Ash content of the hamburger showed a significant difference ($P < 0.05$) as levels of substitution of cashew apple pomace increased from 1.34 to 2.55%. The ash content of fresh lean beef and cashew apple pomance was 1% and 0.97% as reported by Varnan and Sutherland (1995) [11]. The ash content of burgar samples observed in this study is higher than these values. This might be attributed to concentration effect as well as contribution form the items in the recipe. However, the addition of cashew apple pomace was shown to reduce te ash content of burger samples. This might be due to dilution effect. At all levels, ash content of the hamburger were significantly ($P<0.05$) different from each other. This findings is in agreement with Livia *et al* (2011) [12] who reported an increase in the ash content of hamburger as the level of substitution with cashew apple fiber increased from 3.71 to 4.00%.

There is also a significant difference ($P < 0.05$) in the fat content of the hamburgers. Fat content of the hamburgers decreased as the level of substitution of cashew apple pomace increase from 21.06 to 19.11%. This finding is in agreement with Olota (2012) who reported 12.47 to 9.23% as substitution of mushroom in the hamburger increased.

The protein content of hamburger in the present study ranged from 28.87 to 15.81% showing a decrease in the level of substation of cashew apple pomance increase. The progressive inclusion (10%0, 20%, 30%, and 40%) of cashew apple pomance showed decrease in protein content due to dilution effect cashew apple presents low protein content therefore the control sample (100% beef), showed significant deference ($P < 0.05$) compared to the other formulations crude fiber content of the hamburgers were found to increase significantly ($P<0.05$) as the level of substitution of cashew apple pomace increased from 3.38 to 7.41%. This correlates with the findings of Livia *et al*, (2011) [12], who reported an increase in the fibre contnt of hamburger made from 100% beef (0-7.66%) as cashew apple fibre substation increased.

Carbohydrate content of the hamburgers were found to increase significantly ($P<0.5$) as the level of substitution of cashew apple pomace increased form 4.93 to 13.67% Al-Mrazeeq *et al* (2008) [7] obtained values varying from 2.82 to 15.02% for hamburgers added to oatmeal.

The mineral element content of the burger samples decreased generally with progressive addition of cashew apple pomace. Magnesium content of the 100% beef showed no significant ($P>0.05$) difference from hamburgers made form 10%, 20% and 30% cashew apple pomace and it ranged from 0.05 – 0.06mg. The reduction of magnesium content of beef by the presence of cashew apple pomace could be attributed to low magnesium content of cashew apple pomace. In short, all the mineral content of the hamburger decreased with progressive adition of cashew pomace. In short, all the mineral content of the hamburger deceased with progressive addition of cashew pomace.

The sensory scores of hamburgers produced from beef and cashew apple pomace. Hamburger with 100% beef presented the best result for colour, texture taste chewiness, aroma, juiciness and overall acceptability. It was observed that the scores given by the panetlist wer very similar especially between 100% beef, 20% and 10% cashew apple pomace. The decrease in taste with increase in cashew apple pomace levels could therefore be attributed to the decrease in fat content as cashew apple pomace level increase.

Flavor showed no significant ($P>0.05$) between all the hamburgers produce which presented sensory scores ranging from 8.10 to 6.95. The decreasing score with the increasing addition of the cashew apple residue could be a consequence of the presence of tannins, which can influence negatively the acceptance of the product.

Conclusion

The product development as shown in this study provided information of partial substitution of beef with cashew apple pomace improved the product in terms of carbohydrate, crude fibre content, and low in fact when compared to conventional ones, and was higher in proteins when compared to vegetable hamburgers. In view of the outsiding problems of red met consumption, vis-à-vis-a, the numerous health benefits of cashew apply pomace, it is considered safer to partially replace hamburger with cashew, apple pomace for optimum health.

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