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Production and availability of Jackfruit (*Artocarpus heterophyllus*) and Java Plum (*Syzygium cumini*) beans for livestock feeding in Eastern and Central Regions of Uganda

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Abstract

A survey was conducted in the districts of Kampala and Mbale between January and March, 2014 to establish the availability of Jackfruit (JF) and Java plum (JP) beans for poultry feeding. Distribution and productivity of JF and JP trees, interest in the trees, and research that had been done on the trees were also determined. A total of 111 respondents, which included researchers, extension workers and household members were used for the study in two sub-counties from each district. Data were collected using structured questions, observations, and interviews. Secondary sources of data were also reviewed.

All respondents knew JP and JF trees; all respondents were interested in the trees, and acknowledged that they discarded the beans as waste. The majority of respondents (72%) indicated that JP and JF trees produced fruits twice a year. More JP trees were found in peri-urban than rural areas, while the number of JF trees in rural areas did not differ much from those in peri-urban areas. Respondents who had JF trees in their gardens were more (74%) than those with JP trees (58%) but the difference was not significant. The same applied to the number of respondents who purposely grew JF trees being higher (32%) than those who purposely grew JP trees (16%) but the end result of the two groups did not differ much from each other. Of the total respondents who had JP trees in their gardens, 27.6% of them purposely grew the trees using seedlings from nursery beds while 43.2% of the respondents had JF trees grown using the seedlings from the nursery beds. The remaining respondents had JP and JF trees grown naturally in the gardens. The JF trees produced significantly more beans (390kg per tree annually) than JP trees (140kg per tree annually). The annual Jackfruit bean production in the 50 villages covered was 10.3×10^{2} tonnes while Java plum produced 249 tonnes of beans annually. The major limitations to JP and JF production were caterpillar infestation (34%) and injuries caused by accidental falling of children from JP trees (21.3%). Respondents (83.3%) indicated that little research in Uganda had been conducted on JP beans but some work (12.5%) had been done on JP beans and other parts of JP tree to establish their medicinal properties. To ensure constant production of JP and JF beans; multiplication/breeding of the trees, promoting production of the

trees, production of compound feeds having the beans, and developing harvesting and post-harvesting techniques are of paramount importance. The study showed that JP and JF beans were readily available and could be used for livestock feed production.

Key words: *agro-forestry, feed, grafting, medicinal properties, post-harvesting, productivity*

Introduction

The Jackfruit (JF) beans are produced by the fruit of a tree called Jackfruit (*Artocarpus heterophyllus*), locally known as Fene (Figure 1). The tree is adapted to humid tropical and near-tropical climates (Morton 1987) and therefore has the potential to be widely produced in Uganda. Yield of 150-500 fruits per tree annually has been reported (Morton 1987). Although JF pulp is a delicacy among Ugandans, the beans are invariably discarded as waste. The waste beans are available in most markets and trading centres of Uganda. In urban and peri-urban markets, the discarded beans are a potential environmental hazard because they attract flies. However, during food shortage, some people in rural areas roast the beans and prepare a meal that is eaten with maize-meal or potatoes. Though these beans are roasted and eaten by some people, they generally face little competition between humans and livestock.

Figure 1. Jackfruit and Java plum fruits, and product

Conversely, Java plum (JP) beans are produced by the tree called Java plum (*Syzygium cumini*), locally known as Jambula (Figure 1). The tree was introduced in Uganda in the early 1900's by Indians who mainly ate the juicy pulp as ordinary fruit or used the pulp for production of JP jam (Ndyomugyenyi et al 2008). The JP beans left after eating the pulp were of little importance and were therefore always discarded as waste (Ndyomugyenyi et al 2008). A preliminary study showed that phytochemical constituents of raw JP beans included sterols, triterpenes, courmarins, tannins, glycosides, alkaloids, reducing compounds, anthocyanin pigments and saponins, most of which were anti-nutritional factors (Ndyomugyenyi 2008). Currently, JP fruit is mainly eaten by young children who climb trees for fun and collect the fruits, which they enjoy eating. In some parts of Uganda, people use JP fruits to produce wine. However, the beans are always discarded as a waste product. The JP beans have the potential to be widely produced in Uganda because unlike other fruit trees, the trees thrive very well in a variety of soils that include loam, marl, sandy, and calcareous soils (Morton 1987). Both JF and JP beans are potential energy feed resources because they are rich in carbohydrates (Morton 1987; Pankaj 2003). Metabolisable energy content of JP beans was reported to be 13.4 MJ/kg (Ndyomugyenyi et al 2008), while JF beans had the total carbohydrates of 74% (Ravindran et al 1996).

Little work has been done in Uganda to establish the current production of the JF and JP beans for livestock feed. Therefore, this study was conducted to establish the availability of JF and JP beans for poultry feeding. The other objectives were to determine distribution and productivity of JF and JP trees; research that had been done on the trees and the benefits of the trees to the communities.

Methodology

A survey was conducted in the districts of Kampala and Mbale. Kampala is located in the central ($00^{o}19'N\ 032^{o}35'E$) and Mbale in eastern ($01^{o}04'50''N\ 34^{o}10'30''E$) regions of Uganda. Two sub-counties were randomly selected from each district. The respondents included researchers, extension workers and household members. The researchers were selected from institutions that conducted research activities particularly in crops and animals. The data were obtained using structured questionnaires, observations and interviews. Secondary sources of data were also reviewed especially from journal publications, on-line information, district, and sub county headquarters. The data were obtained from 88 purposely selected JF and JP producers and 23 researchers, making a total of 111 respondents.

Results and discussion

General information and interest of respondents in Java plum and Jackfruit trees

All respondents knew Java plum (JP) and Jackfruit (JF) trees and were all interested in the trees (Table 1). Most respondents (72%) indicated that JP and JF trees produced fruits twice a year. All of them also acknowledged that they discarded the beans as waste after eating the pulps of fruits. The JP and JF beans were discarded as waste product because respondents did not know their importance. However, when respondents were informed about possibility of using JP and JF beans as poultry feed resource, they all got interested in the trees. Indicators of respondents' interest in JP and JF trees are shown in their statements below:

- The beans have been wasted. This innovation is therefore very much welcome. Once the product is popularized, many feed compounders will use it for feed making.
- This is going to be one of our enterprises being undertaken together with our already paying Agro-forest Project here.
- The research will result into exploitation of renewable resources, diversification of sources of income and widening of poultry feed base.
- Nobody has taken time to use the beans for anything before. Nobody has taken trouble to prone the Java plum trees so that the harvesting can be done easily.
- There will be reduction of competition with maize bran thereby providing alternative energy sources.
- Energy value and other nutrients in the beans should be assessed and compared with other existing sources.
- I wish to encourage the research on these crops especially for wines and bean use.

Table 1. General information and interest of respondents in Java plum and Jackfruit trees

	Mbale		Kampala		
Sub-county/division	**Bungokho**	**Buwagogo**	**Kawempe**	**Nakawa**	**Total**
No. of respondents	18	17	35	18	88
No. of villages covered	12	13	13	12	50
Total no. of villages[1]	72		396		468
Knowledge of JP and JF trees (%)	100	100	100	100	100
Interest in JP and JF trees (%)	100	100	100	100	100
Discard the JP and JF beans (%)	100	100	100	100	100
Benefits from JP and JF beans (%)	100	100	100	100	100
JP and JF trees fruit twice a year (%)	78	94	77	38	72

[1] *Established by Ministry of Local Government of Uganda*

Distribution and production of Java plum and Jackfruit trees

Respondents who had JP and JF trees in their gardens are shown in Tables 2 and 3 while those who purposely grew the trees are shown in Tables 4 and 5. In Mbale district, more JP trees were found in peri-urban (Bungokho) than rural areas (Buwagogo) (Table 2). This was probably because Asians who introduced the trees used to live mostly in peri-urban areas. However, in Kampala district, there was not much difference between the number of JF trees in rural and peri-urban except Kawempe (peri-urban area), which had a high number of trees because the fruits of JF trees were a source of livelihoods to both communities (Table 3). Generally, respondents who had JF trees in their gardens were more than those with JP trees. However, the difference between JF and JP tree possession was not significant (Tables 2 and 3). This showed that JP trees had the same chances of being grown as JF trees. The only small difference is that JP tree has not been popularized like JF trees because the JP fruits are generally taken as children's food.

Table 2. Respondents who possessed Java plum trees in the gardens[1]

Districts	Sub-county	No. of respondents	% of respondents
Mbale	Bungokho	13	22.4
	Buwagogo	8	13.8
Kampala	Kawempe	26	44.8
	Nakawa	11	19.0
Total		**58**	**100**

Table 3. Respondents who possessed Jackfruit trees in the gardens[1]

Districts	Sub-county	No. of respondents	% of respondents
Mbale	Bungokho	16	21.6
	Buwagogo	13	17.6
Kampala	Kawempe	30	40.5
	Nakawa	15	20.3
Total		**74**	**100**

[1] $t_{3,0.05} = 3.18$ *(two-tail);* $t_{calculated} = 1.0$*;* $r = 0.994$

Respondents who intentionally grew JF trees for fruit production were more than those who purposely grew JP trees (Tables 4 and 5). However, the number of respondents who purposely grew JF trees did not differ much from those who purposely grew JP trees (Tables 4 and 5). Of the total respondents who had JP trees in their gardens, 27.6% of them intentionally grew the trees using seedlings from nursery beds while 43.2% of the respondents purposely grew JF trees using the seedlings from the nursery beds. The remaining respondents had their JP and JF trees naturally grown in the gardens. This meant that most JP and JF trees were naturally grown. However, more than 27% of respondents who purposely grew JF and JP trees were an indication that if additional benefits of the trees were advanced, the trees would be grown in large numbers.

Table 4. Respondents who purposely grew Java plum trees for fruit production[2]

Districts	Sub-county	No. of respondents	% of respondents
Mbale	Bungokho	5	31.3
	Buwagogo	2	12.5
Kampala	Kawempe	6	37.5
	Nakawa	3	18.8
Total		**16**	**100**

Table 5. Respondents who purposely grew Jackfruit trees for fruit production[2]

Districts	Sub-county	No. of respondents	% of respondents
Mbale	Bungokho	8	25.0
	Buwagogo	7	21.9
Kampala	Kawempe	11	34.4
	Nakawa	6	18.8
Total		**32**	**100**

[2] $t_{3,0.05} = 3.18$ *(two-tail);* $t_{calculated} = 1.0$*;* $r = 0.843$

Productivity of Java plum and Jackfruit trees

Each JP tree was estimated to produce 200kg of fruits and 140kg of beans annually; the tree fruits two times annually, and 80% of the total trees were mature. The JP-bean production was estimated by averaging the weight of fallen ripe fruits from 10 randomly selected JP trees. Each

JF tree was estimated to produce an average of 325 fruits annually (Morton 1987); 80% of the total trees were mature. Each JF produced an average of 1.2kg beans estimated by averaging the weights of the beans from each of the five small, medium and large sized Jackfruits (Figure 2).

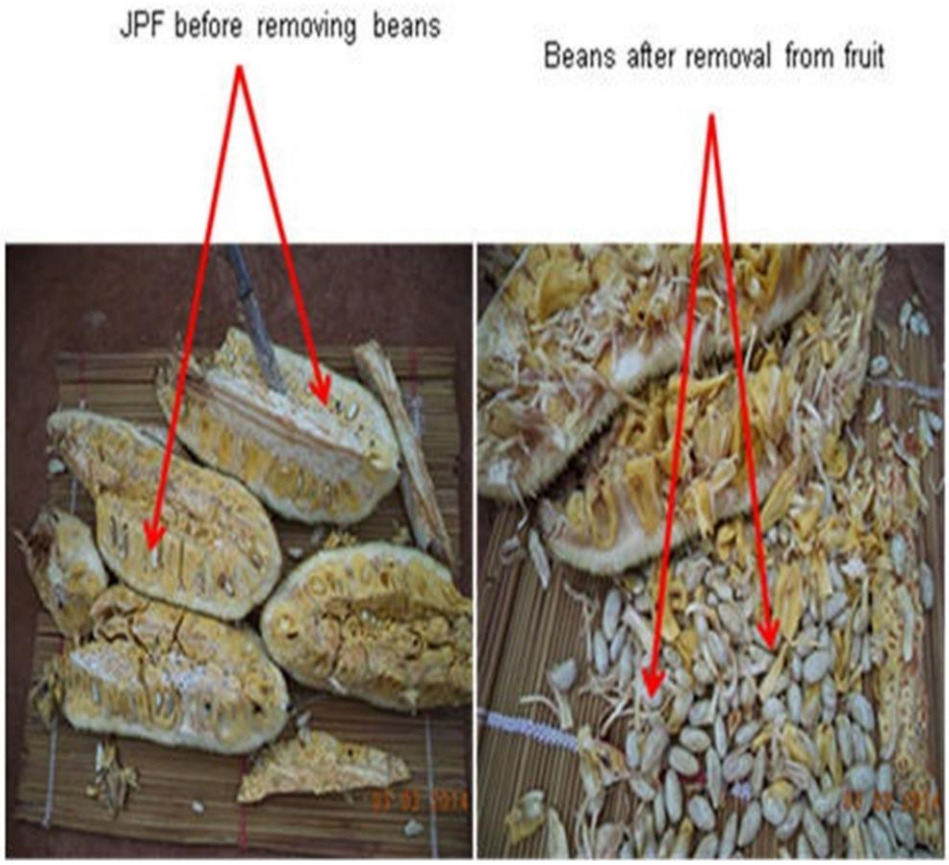

Figure 2. Estimation of the weight of beans produced per Jackfruit

The JF trees produced substantially more beans than JP trees (Tables 6 and 7). This was not only because respondents had many JF trees but also the productivity of JF trees was higher than that of JP trees. Each JP tree yielded 390kg of beans annually compared to JP tree that produced 140kg of the beans annually.

Table 6. Number of Java plum trees and Java plum bean production[3]

Districts	Sub-county	No. of Java plum trees (10^3)	Bean production per year (tonnes)[4]
Mbale	Bungokho	0.830	93.0
	Buwagogo	0.292	32.7
Kampala	Kawempe	0.643	72.0
	Nakawa	0.455	51.0
Total		**2.22**	**249**

[4] *Mature trees (80%*total no. of trees) *70kg of beans per tree*2 seasons/1000.*

Table 7. Number of Jackfruit trees and Jackfruit bean production[3]

Districts	Sub-county	No. of Jack fruit trees (10^2)	Bean production per year (tonnes)[4] (10^2)
Mbale	Bungokho	10.4	3.23
	Buwagogo	5.25	1.64
Kampala	Kawempe	10.9	3.40
	Nakawa	6.45	2.01
Total		33.0	**10.3**

[3] *$t_{3,0.05}$ = 3.18 (two-tail); $t_{calculated}$ = 0.009; r = 0.907*
[4] *Mature trees*1.2kg of beans per fruit* [325fruits per tree annually (Morton 1987)]/1000*.

Limitations to Java plum and Jackfruit production

The most significant limitations to Java plum (JP) and Jackfruit (JF) production was caterpillar infestation and injuries caused by accidental falling of children from JP trees (Table 8). Caterpillar infestation was mostly observed in JP trees (Figure 3). The infestation greatly reduces JP fruit yields because it affects mainly leaves. Caterpillar infestation threat could be prevented by spraying with approved insecticides. Children are prone to accidents due to climbing JP trees because they climb trees for fun and collect the fruits, which they enjoy eating. Once Java plum was commercialized, playing of children on JP trees would be minimized, hence reducing accidents due to falling. The issue of JP and JF trees taking long to grow (five years) was observed by a number of respondents. This would not be a big problem because the trees being perennial are able to produce fruits and beans for a very long period. The longer the period the trees take fruiting, higher the income farmers would obtain. The fruiting period of JP and JF trees could be reduced by innovating grafting technologies. There was also a problem of mass cutting down of JP and JF trees noticed in some peri-urban areas (Kawempe division) of Kampala district. The cutting of the trees was to create space for construction of buildings, firewood for homesteads and burning bricks for construction. The practice of cutting the trees was equally observed among some rural farmers who were creating space for cultivating other crops. The cutting of the trees could be minimized by increasing awareness about the importance of JP and JF trees.

Table 8. Limitations to Java plum and Jackfruit production

Limitation	No. of respondents	% of respondents
Destruction of young Java plum and Jackfruit trees by straying animals	3	6.4
Interference with other crops by draining water and compacting soils	3	6.4
Caterpillar infestation	16	34.0
Falling down of children from Java plum trees causing injuries	10	21.3
Fruit harvesting is very difficult	1	2.1
Mole rat threat	2	4.3
Trees are bulky, requiring large portion of land	2	4.3
Trees long to grow and bear fruits (over 5 years)	9	19.1
Destruction of houses by broken branches of Java plum Trees	1	2.1
Total	**47**	**100**

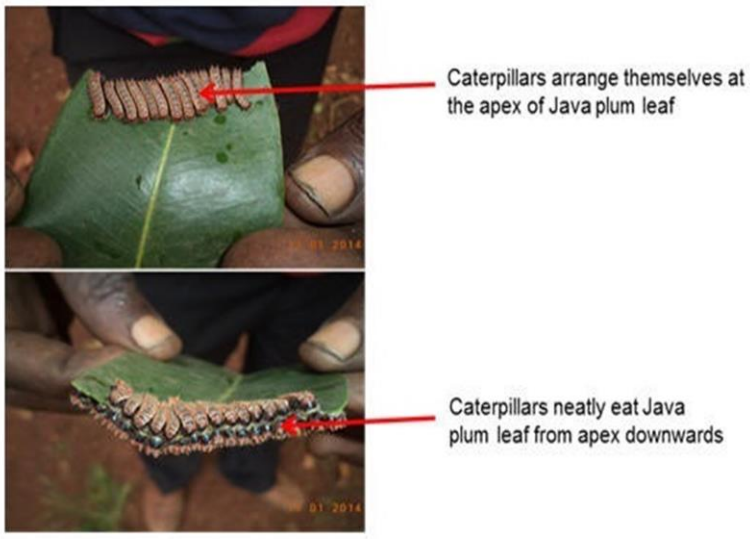

Figure 3. Caterpillar infestation in Jackfruit tree production

Previous research conducted on Java plum and Jackfruit beans

Over 80% of researchers indicated that little research work in Uganda had been conducted on JP beans (Figure 4). However, some studies had been done on the beans and other parts of the plant to establish their medicinal properties and as beverage particularly wine.

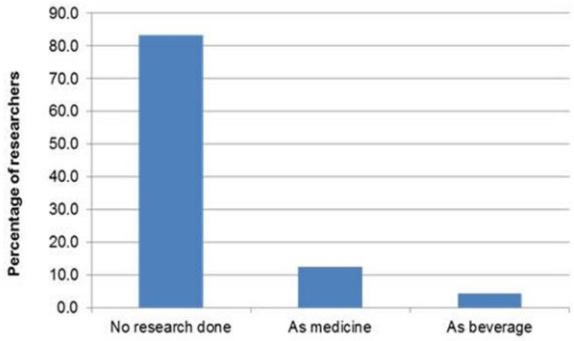

Figure 4. Previous research conducted on Java plum fruits

Elsewhere, the JP trees have been reported to have medicinal properties (Hutchinson 2003). The JP beans possess anti-inflammatory, anti-arthritic and anti-pyretic properties (Duane et al 2004).

The JP fruit pulp is used to make jelly, jam, squash, wine and vinegar (Pankaj 2003). The JP pods are often fermented to make beer (Chhotu 2003). Conversely, the JF beans are caned in brine or tomato sauce, and the roasted, dried beans are ground to make flour that is blended with wheat flour for baking (Morton 1987). The JF beans are usually steamed and eaten as a snack or used in some local dishes (Tulyathan 2001). However, the potential of JP or JF beans as livestock feed has been given little attention.

Sustainability of production of Java plum and Jackfruit beans

Respondents suggested the following ways to sustain production of JP and JF beans:

- Breeding or multiplication of the trees through production of seedlings via nursery beds. Developing varieties of trees that are less bulky would make many the trees to be grown in relatively small portions of land thereby encouraging farmers to produce them.
- Promoting production of the trees beginning with those areas with many trees.
- Encouraging feed manufactures to use the beans for animal production.
- Developing harvesting and post-harvesting techniques to avoid bean wastage. Some methods could be devising harvesting practices, drying and proper storage of the beans.

Conclusions

- Java plum and Jackfruit beans were unused feed resources and were readily available for livestock feed production.
- Little research had been conducted on Java plum and Jackfruit beans as feed for livestock.
- The main limitations to Java plum and Jackfruit production were caterpillar infestation and injuries caused by accidental falling of children from Java plum trees.

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