Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/17858
DOI URL: http://dx.doi.org/10.21474/IJAR01/17858

RESEARCH ARTICLE

POTENTIAL AVAILABILITY OF MANGO BY-PRODUCTS IN THE BOBO-DIOULASSO AND ORODARA AREAS OF BURKINA FASO: ASSESSMENT OF THE QUANTITIES OF MANGO BY-PRODUCTS AND MANGO FEED PRODUCIBLE FOR RUMINANTS

D. X. Millogo[1,2], T. Kiendrébéogo[1,2,3], S. Ouédraogo[1] and S. R. Kondombo[1,2]

1. Laboratoired'Etudes et de Recherches sur les RessourcesNaturelles et les Sciences de l'Environnement(LERNSE)/ Université Nazi Boni, Bobo-Dioulasso, Burkina Faso.
2. Laboratoire de Recherche en Production et SantéAnimale (LRPSA)/Institut de l'Environnement et de RecherchesAgricoles (INERA), Ouagadougou, Burkina Faso.
3. Ministère de l'Agriculture, des RessourcesAnimales et Halieutiques (MARAH),Ouagadougou, Burkina Faso.

Manuscript Info

Manuscript History
Received: 15 September 2023
Final Accepted: 17 October 2023
Published: November 2023

Key words:-
Potential Availability, Mango by-Products, Mango Feed, Ruminant Feed, Burkina Faso

Abstract

The aim of the study was to assess the potential availability of mango by-products in Bobo-Dioulasso and Orodara, with a view to scaling up technologies for their valorization into animal feed. To this end, a cross-sectional survey was conducted among 24 drying units and 17 mango producers. The potential quantities of mango by-products and feed that could be produced were calculated. The results show that the potential quantities of mango by-products in the area were 7,857t for the units surveyed and 16,180t for those in operation. The potential quantities of feed that could be produced with these by-products were 4,190t and 8,427t for the surveyed and functional drying units respectively. Cumulative losses from orchards and drying units amounted to 38,994t, and the potential mango feed that could be produced was 19,486t. The potential nutritional supply from these feeds was 18,792t of dry matter (DM), 1,438t of digestible nitrogenous matter (DNM) and 21,547 UFFV. The surveys showed that mango processing and production by-products are available in the study area. Work is needed to scale up technologies for converting mango by-products into feeds that could be used for fattening. This would create added value for the mango sector, while increasing the availability of feed for animal production.

Introduction:-

Under the combined impact of urbanization, population growth and new socio-cultural expectations, a growing demand for animal products is emerging in southern countries, especially in cities (Mankor2009, Herrero et al2015). Indeed, the population of sub-Saharan Africa is set to double by 2050 (Blama et al., 2016). As a result, demand for animal products, such as meat, milk and eggs, will increase as Gross Domestic Product (GDP) and consumer purchasing power rise (FAO, 2018). In sub-Saharan African countries, forage and nutritional deficits in the dry season, poor pasture management, the high cost and low availability of agricultural by-products (APS) and agro-industrial by-products (AIBS), the low value-added of agricultural by-products and poor feeding practices are the major constraints on livestock production (Kiendrébéogo et al., 2008; Mopaté et al., 2011). In Burkina Faso,

Corresponding Author:- D. X. Millogo
Address:- Laboratoired'Etudes et de Recherches sur les RessourcesNaturelles et les Sciences de l'Environnemen(LERNSE)/ Université Nazi Boni, Bobo-Dioulasso, Burkina Faso.

livestock farming is practised by around 75% of the working population, for whom it contributes to improving living conditions through food and nutritional security, access to basic social services, and the reduction of underemployment and poverty in general(MRA, 2011).However, livestock production in Burkina Faso is not significant. It isfacedwithnumerousdifficultiesthathamperits production, of whichfeedis the main one. Intensification of this type of livestockfarming relies on supplementinganimalswithconventionalfeeds (oilcake, milling bran, wheat bran, etc.) to make up for the nutrientdeficit in pasture forage, whichisvirtually non-existent in the dry season(Millogo et al., 2019). Unfortunately, most of theseconventionalfeeds are not widelyavailable, and evenwhenthey are, they are difficult for the averagefarmer to afford due to their high cost(Kiéma et al., 2019). Facedwith the problem of the availability and high cost of conventionalfeeds, the use of non-conventional by-products in animal feedwould not only enable them to be put to better use, but wouldalsomakequalityfeedsavailable to farmanimals at reducedcost(CIRAD, 2016). Indeed, Burkina Faso's agricultural and agri-foodsectorgeneratesnumerous by-products, such as mango by-products, whose optimal valorization can both help improve animal production performance and reducefeedcosts (CIRAD, 2016).. In the orchards of western Burkina Faso, the main production zone, large quantities of mangoes rot due to fruit flies, resulting in losses of between 30% and 100% (Ouédraogo, 2007). In addition to theselosses, large quantities of mangoes are downgradedfromprocessing to the factory due to damage, to which must beadded the waste (skin, core and pulp) fromprocessing, whichrepresents 20 to 40% of the quantitiesprocessed (Kiendrébéogo et al., 2013). Non-conventional by-products are commonlyusedfresh in animal feed to compensate for certain nutritionaldeficiencies (Kiendrébéogo et al., 2013). They are collecteddirectlyfromrubbish dumps and/or underorchards by strayanimals and by farmers in periods of abundance for the benefit of theirherds. Small-scaleharvesting by strayanimalsfromrubbish dumps and/or underorchards, and by livestockfarmers in periods of abundance for the benefit of theirherds. However, thesedamagedmangoes and by-products, considered as non-conventionalresources, couldbeused for animal feed, providedthey are valorized. For a national annual production of between 160,000 and 300,000 tonnes of mangoes, the economiclosses (upstream and downstream), pollution and waste management problems (downstream) are considerable(Kiendrébéogo et al., 2013). In Burkina Faso, a technology has been developed to convertmango by-productsinto animal feed (Kiendrébéogo et al., 2013). The proveneffectiveness of rations incorporatingmango by-productfeeds has been evaluated on several animal species, includingpigs(Kiendrébéogo et al., 2018 ; Silga, 2016); Isa Brown layers(Kiendrébéogo et al., 2019), local breedhens, "Poulet du Faso" broilers(Ouédraogo et al., 2022)on meat, cow'smilk(Milogo et al., 2022) and egg production (Kiendrébéogo al., 2019). Despitethese conclusive results, itshouldbenotedthatthereislittle or no information on the quantitative and qualitative availability of mango by-products to encourage potential entrepreneurs to use the technology to producemango by-productfeeds for marketing and direct animal feeding. The second concern is that, despite the factthat Burkina Faso, like otherSahelian countries such as Mali and Niger, ismovingtowards intensification of meat production through the development of fatteningactivities, no official scientific information isavailable on the effects of rations incorporatingthem on the production of beef and sheep, the twospeciesused in fattening practices in Burkina Faso. The presentstudy on the "Potentialavailability of mango by-products in the Bobo-Dioulasso and Orodara areas of Burkina Faso: assessment of the quantities of by-products and mango-basedfeedsthatcouldbeproduced for ruminant feeding" isbeingconductedto help generate the knowledgeneeded by cattle and sheep breedersthat aspire to use feedsbased on mango by-products. The aim of the studyis, on the one hand, to estimate the potentialquantities of mango by-productsavailable for feed production in the Bobo-Dioulasso and Orodara areas, and on the other hand, to estimate the potentialquantities of feedbased on these by-productsthatcouldbeused in cattle and sheepfattening practices. The potentialsupply of energy and somenutrients, as well as the levelsthat can beobtainedusingthesenutrients, willalsobeassessed.

Materials and Methods:-

Study area

The study was conductedfrom June to August 2022 in Bobo-Dioulasso and Orodara. These areas were chosen for the fact that they are part of the main mango production and mango processing in Burkina Faso. The geographical coordinates of Bobo-Dioulasso are 11°19'60"N and 4°15 '0"W and Orodara is located at 11°25'00"N and 5°00'00 "W. Bobo-Dioulasso and Orodara are located in the south-Sudanian climate zone between the 1000 and 1200 mm of isohyets . Two seasons alternate: a rainy season of 6 months (May to October) and a dry season of 6 months (Noveer to April).

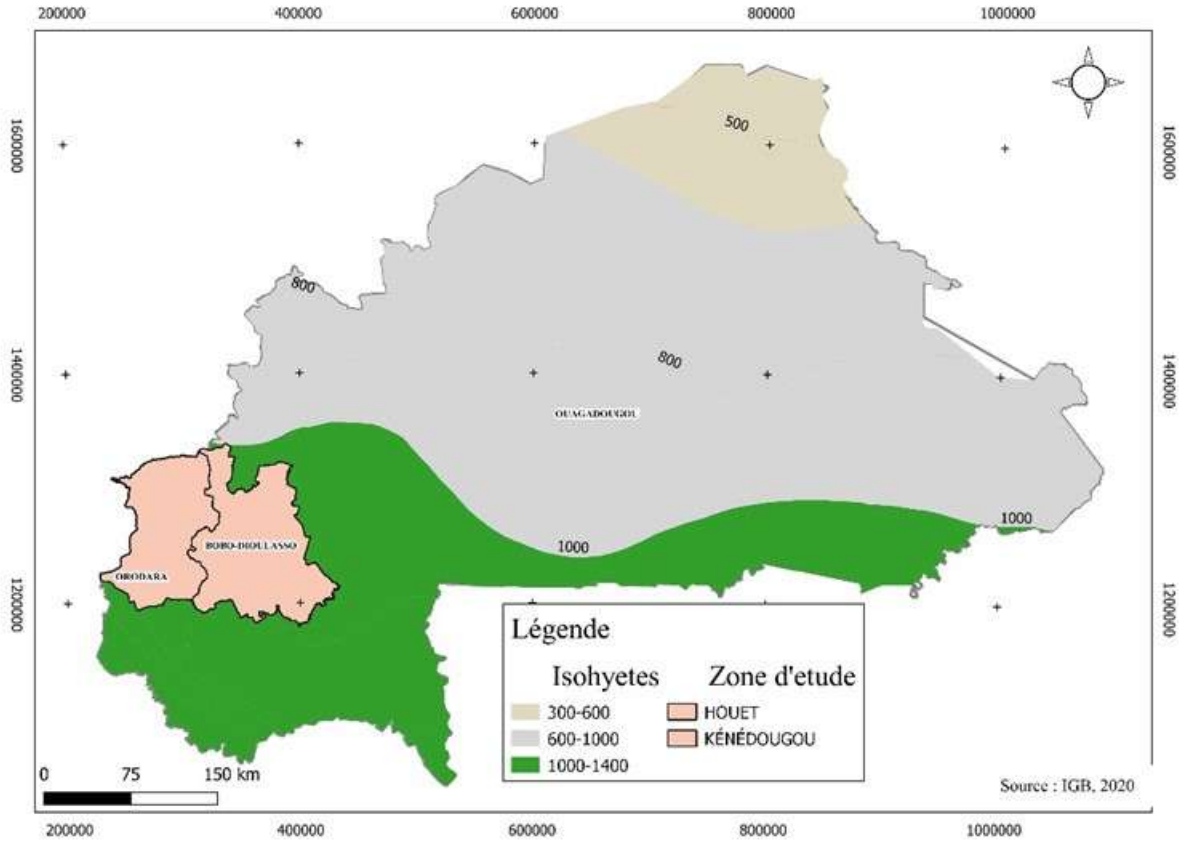

Figure 1:- Location of study zone.

Data collect

In order to account for the availability of mango by-products in the Bobo-Dioulasso and Orodara areas, 03 links in the value chain should be explored: production, processing and marketing. We chose the production and processing links, considering that the marketing link is difficult to control. In order to obtain information in both zones and on the selected links, a single-pass survey was conducted among production (orchards) and processing units. Preliminary interviews with technical support and advisory structures and mango industry umbrella organizations, notably the Association ProfessionnelleMangue Burkina (APROMAB) and the OrganisationProfessionnel de la Transformation de la Mangue du Burkina (PTRAMAB), gave us an idea of the number of mango production and processing units in the 02 zones.

StatisticalAnalyzes

The data collectedwascoded and enteredinto a Microsoft Access 2016 input mask. Theywerethenanalyzedusing Microsoft Excel 2016. The socio-demographiccharacterization of the respondents and the practice of theirmango drying activitywerecarried out usingmeanfrequencycalculations. The potentialavailability of mango by-products and the evaluation of the quantities of by-products and mangofeedthatcouldbeproduced for ruminant feedwerecalculated on the basis of certain production parameters. These are :

- **Potentialquantity of mango by-productsfromprocessingintodriedmango**obtained by calculationfrom the quantitiesproduced by the 24 surveyedunits, extrapolated by rule of three to the 49 functional drying units in the study area using the formula **Potentialquantity of mango by-products (wholemango, skin and pits) at drying unit level** = (quantityproduced by surveyedunits X number of functionalunits in the area)/ number of surveyedunits ;
- **Potentialquantity of production by-products**: [(National area of orchards X 0.58)/Average national yield per ha of production unitssurveyed]/Averageyield of producerssurveyed X (137/17) with a national area = 287,000ha (author) with an average national yield of 7.5t/ha and a yield of producerssurveyed of 7.84t/ha ;
- **Quantities of mangofeedthatcouldbeproduced**using the ratio of 50% and 2% of the quantity of mango by-productsprocessedintomangofeed and mango kernel flourrespectivelyaccording to Koidja and Traoré (Koidja, 2020 ; Traoré, 2020) ;

- **The analytical data fromKoidja**(Koidja, 2020) and the results of samplesanalyzedfrom the 2023 production usingNearInfraRedSpectrometry (NIRS) wereused to assess the nutrient and energy contribution of the mangofeed and mango kernel flourproduced;
- The **potentialintake of** DM, MAD, energy, Ca and P wasconverted per head of cattlewith a ADGof 750g or sheepwith a ADGof 70g fattened for 100 days.

Results:-

Socio-demographiccharacteristics

The surveyinvolved 24 mango drying promoters, including 15 in Bobo-Dioulasso and 9 in Orodara, and 17 mangoproducers in Orodara. Table 1 shows the main socio-demographiccharacteristics of the breederssurveyed. Drying unit promotersweremostly men (91.67%) in the [40-49] agebracket, withsecondaryeducation and lessthan 10 years' experience in the trade. The workforcewaspredominantlyfemale. The mangogrowerswere all men, most of whomhad a primaryschooleducation and [10-20]years' experience in the trade. The majority of mangogrowerswerefarmers, with an averagefarmed area of 7.93ha, and practised pure cultivation (82.35% of them) and intercropping (17.65%). Theyalsopracticed animal husbandry (23.53%) and trade (76.47%) as secondaryactivities.

Table 1:- Socio-demographiccharacteristics of the drying promoters and mangogrowerssurveyed.

Variables	**Modalities**	**Frequencies (%)**	
		Drying units	Producers
Sex	-Man	91.67	100
	-Women	8.33	0
Age	-] 20 ; 29[	10.83	-
	-] 30 ; 39[	8.33	-
	-] 40 ; 49[	53.61	-
	-] 50 ; 59[	18.33	-
	-> 60	8.89	-
Education level	Illiterate	-	41.18
	-Literate	4.17	11.76
	-Primairy	-	35.29
	-Secondary	83.33	11.76
	-Superior	12.5	-
Experience in activity	-] 5 ; 10[	87.78	17.65
	-] 10 ; 15[	3.33	29.41
	-] 15 ; 20[	5.56	41.18
	-> 20	3.33	11.76
Manpower	-Man	5.71	-
	-Woman	94.29	-

Mango by-productin drying units and mangoorchards.

Causes of mango by-product

In mango drying units :

the main by-products of processingare sortingrejectsfromunusablemangoes (bitten by flies, injured for variousreasons) and processingwaste (mango peelings and pits);

Amongmangoproducers:

fruit fly bites (declared by 100% of respondents), cracks and injuries (76.47%) due to falls and poorharvesting practices that are stilltraditional (100% of growers), and the sorting of small-calibre mangoes (76.47%) are the main causes of mango by-product.

Methods and difficulties of managingmango by-products

The main management methods for mango by-products are abandonment in the wild by the drying promoterssurveyed and underorchards by producers. Offering by-products to farmerswaspractised by 16.75% of drying promoters and compostingwasmentioned. The main cause of lossunder the orchardwas fruit fly (100%), and

the majority of respondents (76.47%) Mangoesunfit for consumptionwereabandoned in the orchardwithout management (table 2).

Table 2:- Management of mangoprocessing and production by-products.

Variables		Production type	
		Dried mango (%)	Fresh mango (%)
abandoned in the wild		77	0
Abandon in orchards		2.08	76.47
Abandoned in landfills		2.08	0
Animal feed	Don	10.08	0
	sale	6.67	0
Composting		2.08	23.53

Averagepotential of mango by-products and theirprocessinginto animal feed

In the orchards :

The potentialquantities of mango by-productsavailable in all orchards in the two (2) zones amounted to 22,814 t (Table 3). The total potentialquantity of mangofeed (feed and kernels) thatcouldbeproducedfromthese by-productswasestimated at 11,863 t.

In the mango drying units :

The potentialquantities of mango by-productsavailable in the surveyed drying units and in all functionalunits in the two (2) zones wererespectively 7,857 t and 16,180 t in total. The total potentialquantities of mangofeed (feed and kernels) thatcouldbeproducedfromthese by-productswereestimated at 4,190 t and 8,427 t respectively for the surveyed drying units and for all functionalunits in the study area (Table 4). In total, cumulative lossesfromorchards and functional drying unitsamounted to 38,994 t, and the mangofeedthatcouldbeproducedfromthese by-productswasestimated at 19,486 t.

Table 3:- Mango production and by-products in Surveyedorchards.

Variables			Mangoes varieties				Frequencies (%)
			Amélie	Brooks	Lipens	Kent	
Production	surveyeds (n=17)	Average	19±11.34	13±7.43	23±15.73	8±7	53±30.73
		Total	337	185	278	107	907
	Potential	Total	-	-	-	-	48456
by-products	Surveyeds	Mean	2±1.71	5±3.84	0±0.52	0±0.58	8±3.73
		Total	36.2	88	5	7	137
		%	10.74	47.7	1.96	6.96	15.14
	Potential	Total	-	-	-	-	22 814
Mango feed	Provende	-	-	-	-	-	11407
	kernel flour	-	-	-	-	-	456
	Total feeds	-	-	-	-	-	11863

Estimating the number of animals to befedwithpotentialsupply of nutrients and energy

The potentialsupply of nutrients and energyfrom the produciblemangofeedwas 18,792t DM, 1438t of digestible nitrogenousmatter (DNM, 85t Calcium, 40t Phosphorus and 21547 FU. This supply of energy and nutrients can cover the DM, MAD and energyrequirements of 19,791, 17,305 and 34,086 cattlerespectively, or 16,7037, 150,123 and 224,449 sheepsfattening over 100 days (Table 5).

Table 5:- Potentialhead production in 100 days as a function of energyintake, dry matter (DM), digestible nitrogenmatter (DNM) and energy (FU).

Nutrients/Energy	Production			offering	
	Provend	Kernel	Total	Sheep *	Cattle**
Dry Matter(DM))	18 079	712	18 792	167 037	19 791
Digestible NitrogenMatter (DNM)	1 381	57	1 438	150 123	17 305
Calcium (Ca)	84	1	85	173 559	25 741
Phosphorus (P)	38	3	40	135 031	21 356
Metabolizable energy (FU)	20 755	792	21 547	224 449	34 086

**Cattleproducing 750 g ADG in 120 days ; *Local breedsheepproducing 70 g AGD in 120 days.

Production and processingdifficulties

In mango drying units :

The main constraintsidentifiedwere management of by-products (spoiledmangoes and processingwaste) (85%), lack of gas (42.11%), conflictswith municipal and environmentalauthorities (21.05%) and lack of financialresources (21.05%).

Amongmangogrowers :

Pest control (76.47%), poor sales (23.53%), lack of resources (23.53%), lack of support (17.65%) and unsuitable production equipment (11.76%) were the main difficulties.

Discussion:-

Socio-demographiccharacteristics of drying units Our results show the lowinvolvement of women and young people in mangoprocessing. This couldbeexplained by the factthat setting up a drying unit requires a biginvestmentthatis not alwayswithin the reach of women and young people. The lowinvolvement of young people wasnoted by (Kanté-Traoré, 2017), whoreportedthatonly 15% of young people wereinvolved in mangoprocessing in Burkina Faso. In contrast, ARCHIPELAGO (2020) reports that in the Hauts-Bassins mangosector, young people account for 25%, 15%, 5% and 100% respectively of seedlingproducers, grafters, arboriculturists, orchard maintenance workers and pickers. Womenaccount for 24% of pickers. For thisauthor, the proportions are more representative, with an average of 45.71% young people and 72.74% women in the variousprocessingtrades.

Causes of mango by-productlosses

Our results show that in mangoorchards, by-productlosses are mainly due to fruit fly bites, poorharvesting practices and injuries caused by fallsfromvarious causes. Mass infestation of orchards by fruit flies has been reported by LeFaso.net (2023) and Fall et al., (2019) as the main cause of the massive mangolossobserved in orchards in Orodara, Burkina Faso and Casamance, Senegal, respectively. ARCHIPELAGO (2020) reports that the drop in freshmango production in Burkina Faso in 2017 (150,000 tons VS 200,000 tons in 2016) islinked to heavy fruit flyattacks. At the level of drying units, ourresultslistsortingdeviations and unwanted parts in the transformables (skins and pits) as causes of losses. In fact, the processing of freshmangointodriedmangoretainsonly the good pulp, whichrepresents 40.63%, comparedwith 59.38% representing the non-processable parts (Rivier et al., 2023).

Management of mangolosses and processingwaste

As far as the management of processingwasteisconcerned, the majority of drying units dispose of it in the wild, or on landfill sites identified by the commune. Apart from the smallamountstaken by somefarmers (pig breeders) or by strayanimals, thisis the main fate reserved for mangoprocessingwaste. The same observations were made by Sanon et al., 2013), whostatedthat a small proportion of mangoprocessingwasteisconsumed by animals, but most of itisdumped in the wild, posing an environmentalproblem. This beingsaid, the management of processing by-productsconstitutes the major difficulty of the mango drying process. In addition to thisloss of material, extra transport costs are incurred to move thiswasteawayfrom the drying unit. Disposing of processing by-products in the naturalenvironmentis a source of environmental pollution and nuisance for local residents, provokingconflicts not onlywiththeseresidents, but alsowith the municipal and environmental services responsible for enforcinglegislation to ensure a healthy production and living environment.

Potentialavailability of mango by-products for processingintolivestockfeed

Our results show a significantactual and potentialavailability of by-productsfrommango production and processingintodriedmango, averagingaround 17% of production and supplyquantities. At the end of ourstudy, weconsidertheselosses as availablerawmaterialthat can betransformedintofeed for livestock rings, particularly for cattle and sheepfattening. Our survey data showedthatmango by-products are available in the Bobo-Dioulasso and Orodara areas during the processingseason, whichlasts an average of four (4) months, corresponding to the period of mangoavailability. These by-products, considered as recovered and recycledwaste, couldbeused to produce 18,079 tonnes of mangofeed by adding an absorbent (cereal bran or straw) crushedusing the process developed by Kiendrébéogo et al. (2013) and applied by Silga(2016), Koidja (2020) et Traoré (2020). We can understand the search for alternatives for the management of by-products in the context of animal feed and compost production reported by ourownresults. However, in the case of animal feed, the amount of by-productsisinsignificantcomparedwith the hugequantitiesavailable. Therefore, the production of driedmangoflour and meal for animal feedusing the process developed by Kiendrébéogo et al. (2013)appears to be a credible alternative for the management of mango production and processing by-products.Potentialavailability of feed, energy and somenutrients for animal production.Our results show that the valorization of mango by-productspreviouslyabandoned in orchards or discarded in the wild or in landfillswouldmake large quantities of feed and mango fine mealavailable for animal feed. Moreover, thesefeedscouldmakeavailable large quantities of dry matter, energy and nutrientssuch as nitrogen, calcium and phosphorus for animal feed, as demonstrated by numerousauthors in Burkina Faso Silga(2016 ; Barry at al., 2019 ; Ouédraogo et al., 2022 ; Kiendrébéogo et al., 2019). This availability of energy and nutrientscouldbesufficient to meet the DM, MAD and energyrequirements of 16.65%, 14.56% and 29.33% respectively of the cattlein the Houet and Kénédougou aera, or 183.20%, 164.65% and 246.17% of the sheepin the same area, according to the ENECII (MED et MRA, 2004) whichwouldbefattened for 100 days.

Conclusion:-

This study made it possible to estimate the potential quantitative availability and the potentialsupply of nutrients and energyfrommango by-products in Bobo-Dioulasso and Orodara. The results of the surveyshowedthatmango by-products are available in both areas and can bevalorized in animal feed. The feedproducedfromtheselossescouldmakeavailable large quantities of dry matter, energy and nutrientssuch as nitrogen, calcium and phosphorus for animal feed. Mango feeds can thereforeact as a feedsupplement for livestock, especially in the dry seasonwhen forage becomesscarce on rangelands. They can help correct the quantitative and qualitative imbalance in animal rations with regard to theirnutritional value. Despitetheiravailability and theirnutrient and energy content, mango by-products are little or not valorized in animal feed in Burkina. On the other hand, the quantitiesavailable show thatthese by-productscouldconstitute a significant and cost-effective source of feed for animals, once anti-nutritionalfactors are reduced and theirdigestibilityimproved by alternative processingmethods. Furtherscientificworkisthereforerequired in this area.

References:-

1. A. Mankor, « Consommationurbaine de viandesen Afrique de l'Ouest : l'exemple de Dakar », no no 46-47 — mars – août 2009, 2009, [Enligne]. Disponible sur: https://www.inter-reseaux.org ›
2. R. Herrero et al., « Acceptability and satisfaction of an ICTs-based training for university teachers ». 2015.
3. Y. Blama, K. Souleymanou, et C. Rigolot, « Analysetechnico-économique des unitésd'embouche bovine en zone semi-aride du Cameroun », Afrique Science : revue internationale des sciences et technologies, vol. 12, no 2, p. 15-28, mars 2016.
4. « FAO, 2018. L'avenir de l'alimentation et l'agriculture: scénarios pour les voies de développementalternatif à l'horizon 2050. À paraître, Rome: FAO. - Recherche Google ». Consulté le: 3 octobre 2023. [Enligne]. Disponible sur: https://www.google.com/search
5. T. Kiendrébéogo, S. Hamadou, L. Y. Mopaté, et C. Y. Kaboré-Zoungrana, « Typologie des élevagesporcinsurbains et périurbains de Bobo-Dioulasso (Burkina Faso) », Revue Africaine de Santé et des Productions Animales (RASPA), vol. 6, no 3-4, p. 205-212, 2008.
6. L. Y. Mopate, C. Y. Kabore-Zoungrana, et B. Facho, « Structure des troupeaux et performances des élevagesporcins de la zone de N'Djaména au Tchad », International Journal of Biological and Chemical Sciences, vol. 5, no 1, 2011.

7. MRA (Ministère des RessourcesAnimales, « Contribution de l'élevage à l'économie et à la luttecontre la pauvreté, les déterminants de son développement ; Ouagadougou, 80p - Recherche Google », Burkina Faso, 2011. Consulté le: 3 octobre 2023. [Enligne]. Disponible sur: https://www.google.com/search
8. M. Ira, « Optimisation de la production laitière et réduction de l'intervallevêlage-vêlage chez la vache dans la zone périurbaine de Bobo-Dioulasso. ».
9. V. Millogo, M. Sissao, A. G. Sidibe-Anago, T. O. Amoussou, et G. A. Ouedraogo, « Effetd'unecomplémentationvalorisant les ressourceslocalementdisponibles sur les performances de production laitière des vaches envue de réduirel'intervallevêlage-vêlageen zone périurbaine de Bobo-Dioulasso au Burkina Faso », Journal of Applied Biosciences, vol. 142, p. 14575-14586, 2019.
10. S. KIEMA, L. Kini, S. OUEDRAOGO, et C. Y. KABORE/ZOUNGRANA, « Effet de l'utilisation des gousses de Faidherbiaalbida sur les performances de croissance des taurillons à l'Ouest du Burkina Faso », Sciences Naturelles et Appliquées, vol. 38, no 2, Art. no 2, 2019, Consulté le: 3 octobre 2023. [Enligne]. Disponible sur: https://revuesciences-techniquesburkina.org/index.php/sciences_naturelles_et_appliquee/article/view/664
11. CIRAD, « Drêcheensilée, tourteau de palmiste et coques de cacao Digestibilitécomparée des rations contenant de la drêcheensilée des brasseries, du tourteau de palmisteou des coques de cacao chez le porcencroissancefinition au Cameroun déterminer la digestibilité des rations contenant des taux croissants de la drêcheensilée des brasseries, du tourteau de palmiste et des coques de cacao chez le porcencroissancefinition. » Consulté le: 3 octobre 2023. [Enligne]. Disponible sur: https://www.google.com/search
12. OUEDRAOGO S N, « Etude des attaques des mouches des fruits (DipteraTephritidae) sur la mangue dans la Province du Kénédougou (ouest du Burkina Faso) », Université Nazi Boni, Bobo-Dioulasso, Burkina Faso, 2007.
13. K. Timbilfou, M. L. Youssouf, I. Georges, et K.-Z. Chantal-Yvette, « Procédés de production d'aliments non conventionnels pour porcs à base de déchets de mangues et détermination de leursvaleursalimentaires au Burkina Faso », Journal of Applied Biosciences, vol. 67, p. 5261-5270, 2013.
14. K. Timbilfou, M. L. Youssouf, I. Georges, et K.-Z. Chantal-Yvette, « Procédés de production d'aliments non conventionnels pour porcs à base de déchets de mangues et détermination de leursvaleursalimentaires au Burkina Faso », Journal of Applied Biosciences, vol. 67, p. 5261-5270, 2013.
15. T. Kiendrebeogo, Y. M. Logténé, et C.-Y. Kaboré-Zoungrana, « Effets de rations à base de déchets de mangue sur les performances pondérales et la qualité de la carcasse de porcsKorhogoencroissance au Burkina Faso », Journal of Applied Biosciences, vol. 129, p. 13039-13049, 2018.
16. V. SILGA, « Effets de rations à base de déchets de mangue sur les performances pondérales et des carcasses de porcsmétis. Mémoire d' ingenieur de conception enElevage. UPB/IDR, Bobo-Dioulasso, Burkina Faso. 41 p. », Université Nazi Boni Bobo-Dioulasso/Burkina Faso, 2016. Consulté le: 20 octobre 2023. [Enligne]. Disponible sur: https://www.google.com
17. D. Barry, T. Kiendrebeogo, M. Sere, A. Combari, Y. M. Logténé, et C. Y. Kaboré-Zoungrana, « Effects of Mango Wastes-Based Diets on the Growing Parameters of Laying Hens and Biometric Parameters of the Eggs », Open Access Library Journal, vol. 6, no 11, Art. no 11, nov. 2019, doi: 10.4236/oalib.1105868.
18. T. Kiendrebeogo, C. Sawadogo, A. Soudre, A. Combari, Y. MopateLogtene, et C. Y. Chantal-Yvette Kabore-Zoungrana, « Effects of mango waste-based rations on the technical-economic performance of local growing-finishing chickens in Burkina Faso », International Journal of Innovation and Applied Studies, vol. 29, no 1, p. 97-103, 2020.
19. I. Z. OUEDRAOGO, T. KIENDREBEOGO, D. Xavier, D. P. SAWADOGO, H. KOARA, et V. M. BOUGOUMA-YAMEOGO, « Influence de rations incorporant des provendes de mangues et un concentréd'asticotsenremplacement au maïs et à la farine de poisson sur les performances de croissance et la qualité des carcasses de poulets de chair" poulet de Faso. », 2022, Consulté le: 20 octobre 2023. [Enligne]. Disponible sur: https://revist.net/REVIST_39/8-ST-836.pdf
20. X. D. Milogo, T. Kiendrebeogo, I. Z. Ouedraogo, H. Koara, D. P. Sawadogo, et V. M. Bougouma-Yameogo, « Influence of Mango Feed-Based Diets on the Production and Economic Profitability of Montbeliarde Cows' Milk at the End of Lactation in Burkina Faso », Open Journal of Animal Sciences, vol. 12, no 2, p. 239-250, 2022.
21. M. S. G. KOIDJA, « Efficacitécomparée aux séchage de provendes de mangueincorporant divers absorbantsalimentaires », Université Catholique de l'Afrique de l'Ouest, Bobo-Dioulasso, Burkina Faso, 2020. Consulté le: 6 novembre 2023. [Enligne]. Disponible sur: https://www.cabi.org › gara › FullTextPDF
22. A. TRAORE, « Valorisationd'aliments a base de sous-produits de mangue dans le rationnement de poulets de chair », Université Catholique de l'Afrique de l'Ouest, Bobo-Dioulasso, Burkina Faso, 2020. Consulté le: 6 novembre 2023. [Enligne]. Disponible sur: https://www.scirp.org ›

23. H. Kante-Traore, H. Sawadogo-Lingani, I. Seogo, D. Kabore, et M. H. Dicko, « Procédés de transformation de la mangue et niveau de connaissance des normes de qualité par les unités de production au Burkina Faso », International Journal of Biological and Chemical Sciences, vol. 11, no 1, p. 195-207, 2017.
24. ARCHIPELAGO, « Rapport de l'étude sur la filièremangue dans les régions des Hauts-Bassins, des cascades et du centre. Bobo-Dioulasso, Burkina Faso, 103p. », 2020. Consulté le: 6 novembre 2023. [Enligne]. Disponible sur: https://cmacooperation.fr/wp-content/uploads/2021/03/rapport-etude-filiere-mangue_archipelago-mangue.
25. LeFaso.net, « Production de mangues au Burkina FAso : La mouche de fruit fait des dégâts. » Consulté le: 6 novembre 2023. [Enligne]. Disponible sur: https://lefaso.net/spip.php?article37905
26. A. Fall, M. Toure, F. Seye, R. D. Ndione, T. Seydou, et B. Wade, « Evaluation des pertescausées par Rastrococcusinvadens (Willams, 1986) (Homoptera, Pseudococcidae) sur la mangue au Sénégal (Casamance) », 2019, [Enligne]. Disponible sur: https://www.m.elewa.org/Journals/wp-content/uploads/2019/04/1.BLCKED.pdf
27. Rivier, M., Méot, J.-M., Ferré, et , T., Briard, M., Le séchage des mangues., Éditions Quae. 2009. Consulté le: 6 novembre 2023. [Enligne]. Disponible sur: https://doi.org/10.35690/978-2-7592-0342-0
28. H. O. Sanon, A. B. Kanwe, A. Millogo, et I. Ledin, « Chemical composition, digestibility, and voluntary feed intake of mango residues by sheep », Trop Anim Health Prod, vol. 45, no 2, p. 665-669, févr. 2013, doi: 10.1007/s11250-012-0275-1.
29. T. Kiendrebeogo, Y. M. Logténé, et C.-Y. Kaboré-Zoungrana, « Effets de rations à base de déchets de mangue sur les performances pondérales et la qualité de la carcasse de porcsKorhogoencroissance au Burkina Faso », J. App. Bioscience., vol. 129, no 1, p. 13039, janv. 2019, doi: 10.4314/jab.v129i1.7.
30. MED et MRA, « deuxièmeenquêtenationale sur l'effectif du cheftel au burkina Faso - Recherche Google », Ouagadougou/Burkina Faso, 2004. Consulté le: 6 novembre 2023. [Enligne]. Disponible sur: http://hubrural.org › IMG › pdf › burkina_enec...
31. S. W. Coleman, S. P. Hart, et T. Sahlu, « Relationships among forage chemistry, rumination and retention time with intake and digestibility of hay by goats », Small Ruminant Research, vol. 50, no 1-2, p. 129-140, oct. 2003, doi: 10.1016/S0921-4488(03)00116-0.
32. M. Montcho, B. Severin, B. Aboh, M. Bahini, A. Chrysostome, et G. Mensah, « Disponibilite, ValeursMarchande Et Nutritionnelle Des Sous-ProduitsAgricoles Et AgroindustrielsUtilises Dans L'alimentation Des Ruminants Au Benin », European Scientific Journal, vol. 12, nov. 2016, doi: 10.19044/esj.2016.v12n33p422.
33. J. Bindelle et A. Buldgen, « Utilisation des plantes à tuberculesou à racinestubéreusesen alimentation animale. », Troupeaux et cultures des tropiques, vol. 4, 2004.