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Project final report

project	**Feeding papaya fruits and betel nuts to reduce parasite burdens and increase growth rate in pigs**
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Contents

1 Acknowledgments 3

2 Executive summary 3

3 Background 4

4 Objectives 5

5 Methodology 5

6 Achievements against activities and outputs/milestones 7

7 Key results and discussion 7

8 Impacts 9

8.1 Scientific impacts – now and in 5 years 9

8.2 Capacity impacts – now and in 5 years 9

8.3 Community impacts – now and in 5 years 10

8.4 Communication and dissemination activities 10

9 Conclusions and recommendations 10

9.1 Conclusions 10

9.2 Recommendations 10

10 References 11

10.1 References cited in report 11

10.2 List of publications produced by project 11

11 Appendixes 11

11.1 Appendix 1 11

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2 Executive summary

Internal parasites have been identified as a major health problem impacting on the growth and viability of pigs in many parts of the world, including Indonesia, and published surveys indicate that a wide range of species of endoparasites are present. The more common species include *Trichuris suis, Ascaris suum,* lungworm and kidney worm as well as several species of protozoa.

The range of parasites with both direct and indirect life cycles presents a challenge in developing treatment and husbandry systems that control parasitism in growing pigs. One of the major outcomes from the ACIAR funded project, AS1/1998/054 - Poverty alleviation and food security through improving the sweet potato-pig systems in Papua Indonesia, has been the development of a pig flow and management system that involve the use of dunging areas and rotational foraging of high protein pasture grasses. However, even in this modified system, pigs develop significant parasite burdens within 3 to 5 months. Although parasiticides are available in most pig raising regions of the world, in some areas either cost or availability limits their use by local small scale farmers.

As an alternative to using commercial parasiticides, supplementation of diets with papaya fruit, betel nut and pineapple leaves was investigated as cheaper an effective means of controlling parasitism in village pigs. The results from preliminary experiments feeding pigs with either papaya fruit or betel nut were encouraging, but pigs would neither eat the leaves, nor drink an infusion produced from boiling the leaves

Dose response experiments were then designed to determine the optimum quantities of fruit and nut that should be fed to pigs to control endoparasitism. The data from these experiments was then used to design field trials using native pigs collected in the Baliem Valley. Pigs with significant Trichuris and Ascarid faecal egg counts, and weighing approximately 10 kg, were allocated to one of 3 groups. Two groups of pigs were fed either 533g papaya fruit/10 kg body weight/day for 5 consecutive days over 4 weeks, or 4g ground betel nut/10kg body weight once, and a third group was fed the same diet without supplementation. The diet contained 33% cooked SP-vines + 22% cooked SP roots + 34% ensilaged SP tubers and vines + 11% cooked banana trunk. The ensilaged material contained 85 kg SP roots + 15 kg SP-vines + 0.5 kg salt and was fermented for 14 days.

Following dietary supplementation, faecal egg counts in pigs fed either papaya fruit or betel nut were reduced to zero over a 2 to 3 weeks period, whereas faecal egg counts increased weekly in untreated pigs. Trichuris eggs increased from around 200 to above 500 eggs per gram (EpG) of faeces and Ascarid eggs increased from approximately 1,000 to between 6,000 and 7,000 EpG over the 8 week period. The control group was disbanded in the 8th week on welfare grounds and pigs treated with an anthelmintic. Pigs in the treatment groups were maintained until the end of 12th week when faecal egg counts were still zero.

While pigs in the control group lost weight. (– 27 ± 13.2 g/day) over the 8 week period, pigs supplemented with either betel nut or papaya fruit recorded positive growth rates (82 ± 5.40 and 71 ± 9.46 g/day respectively over the 8 week period. Growth rates over the 12 week period were 92 ± 6.34 and 82 ± 6.34 g/day respectively.

The reduction in mortality and increased growth rates recorded for treated pigs was valued at more than AUD$120/pig, grossing farmers with from AUD$ 160 to 190/treated pig compared with AUD $40/pig for untreated pigs.

The results validate the feeding of either papaya fruit or betel nut to reduce and control parasite burdens in growing pigs in the short to medium term, and, while both had similar efficacies, betel nut proved to be more sustainable due to availability and ease of administration.

3 Background

Internal parasites have been identified as the major health problem impacting on the growth and viability of pigs in the Jayawijaya Regency of Papua Province Indonesia. In a disease survey completed in 2002 (Putra et al 2004; Damriyasa et al 2005), all the major internal parasites of pigs were identified. The list of parasites found in the gastro-intestinal tract included *Oesophagostomum dentatum* and *O. quadrispinulatum, Trichuris suis, Globocephalus sexalatus, G. urosubulatus, Ascarus suum, Ascarop strongylina, Macrocanthoryncus hirudinaceus, Strongyloides ransomi, Ascarus suum, Gnathostoma,* and *Physocephalus sexalatus*. Lungworm and kidney worm were also identified along with several species of protozoa.

The range of parasites identified provides a challenge in developing husbandry and control programmes to reduce their impact. Both parasites with a direct life cycle, as well as parasites with an indirect life cycle, were recorded. The parasites with an indirect life cycle include lungworm and kidney worm, which have earthworms as the secondary host, and *Physocephalus sp.*, which has dung beetles as the secondary host. The results also mean that at least two different classes of parasiticides would be needed to effectively control the parasites identified. Although parasiticides are available in most pig raising regions of the world, there are isolated pockets where they are not readily available or beyond the means of local farmers. These include areas such as the Jayawijaya Regency of Papua, as well as other more isolated areas cross the Eastern Provinces of Indonesia, Melanesia and the Pacific. One of the major outcomes from the ACIAR funded project (AS1/1998/054 - Poverty alleviation and food security through improving the sweet potato-pig systems in Papua Indonesia) has been the development of pig raising systems that reduce parasite burdens in growing pigs and increase growth rates by up to 80%. The modifications in pig flow and management involved the introduction of dunging areas and rotational foraging of high protein pasture grasses. However, even in this modified system, pigs develop significant parasite burdens within 3 to 5 months.

In other regions Papaya fruit (*Carica papaya*) has been used to treat Amoebic dysentery in humans and the seeds are used for the traditional treatments of diarrhoea in Tonga, Brazil and parts of Africa. Preliminary efficacy against parasites has also been demonstrated with papaya latex in mice (Satrija et al). Betel nut (Pinang or Areca nut) has also been used to treat pigs for parasites and is quoted as a treatment for pig parasites in a book on herbal medicine published by ASEAN.

In the absence of regular treatment, an approach using medicinal plants to reduce or limit the build up of parasite burdens was considered and preliminary trials feeding pigs with papaya fruit and betel nut have produced encouraging results.

4 Objectives

To validate the efficacy of feeding papaya fruit (*Carica* papaya) and betel nut (Pinang or Areca nut) on a regular basis to reduce internal parasite burdens in growing pigs.

5 Methodology

Dose Response Experiments

An initial experiment was designed to determine the dose response for both whole papaya fruit (latex and seeds) and betel nut. Whole green papaya fruit were collected and chopped before feeding to pigs (Figures 1 and 2) whereas betel nuts were ground into powder before feeding (Figures 3 and 4)

Faecal samples were collected from 50 pigs weighing approximately 15 kg and examined for evidence of parasitism using routine faecal egg counts. Thirty six pigs with egg counts in the following ranges were selected for the experiment.

The ranges set for each parasite were as follows:

Ascaris suum: 250 – 2,500 EpG;
Strongyle sp: 2,000 – 15,000 EpG;
Trichuris suis: 1,000 – 5,000 EpG.

The 36 selected pigs were randomly allocated to one of six groups with one group acting as an untreated control (Table 1). Three groups were fed papaya fruit daily for five days at three intake levels – (267g; 533 and 1.07 kg/10kg body weight/day for 5 consecutive days) and two groups were treated once with betel nuts at either 3g or 4g/10kg body weight once.

Table 1: Treatment schedule for each group in the dose response experiments

	GROUPS					
	A	B	C	D	E	F
Number pigs	6	6	6	6	6	6
Treatment	Papaya fruit			Betel nut		Control
Dose rate	267 g1	533 g1	1.07 kg	3g/10kg	4g/10kg	Nil
Period (days)	5 days	5 days	5 days	1 day	1 day	Nil

[1.] *g/10 kg body weight/day*

Following treatment, pigs were monitored daily for 2 weeks using faecal egg counts and examining faeces for expelled parasites. At the conclusion of the experiment, 2 pigs from each group were killed and total worm counts performed. The remainder of the pigs were sold to recover the purchase price.

Table 2: The activity and treatment schedule for the dose response experiments

Activity	Weeks					
	I	II	III	IV	V	VI
Survey						
Adaptation						
Treated						
Faecal examination						
Evaluation						
Report						

Field Trial Experiments

Once the optimal dose was determined, a field trial was designed to validate the efficacy of adding either papaya fruit or betel nuts to Wamena #2 diet (Appendix 1) to reduce parasite burdens and increase growth rate in growing pigs.

Pigs weighing approximately 10kg were collected from farmers in the village of Napua and added to pigs supplied by the Jayawijaya Livestock Office. All pigs were vaccinated against Swine Fever, and then infected by feeding faeces from pigs with positive faecal egg counts. Faecal egg counts were monitored weekly and when parasite infestation had developed, the pigs were weighed and divided into 3 groups based on parasite egg counts and body weight. One group was fed whole papaya fruit added at the rate of 533g/10 kg body weight/pig for 5 consecutive days each week for 4 weeks. One group was fed betel nut at the rate of 4g/10kg pig liveweight once weekly for 4 weeks. A third group remain untreated. Pigs were weighed monthly and faecal samples collected for faecal parasite egg count estimation.

Figure 1 and 2: Whole green papaya fruit chopped and fed to pigs

***Figure 3 and 4**: Ground betel nut fed to pigs*

6 Achievements against activities and outputs/milestones

Objective 1: To validate the efficacy of feeding papaya fruit (Carica papaya) and betel nut (Pinang or Areca nut) on a regular basis to reduce internal parasite burdens in growing pigs.

No.	activity	outputs/ milestones	completion date	Comments
1.1	Dose response experiments	Dose rate response determine and dose set	January 2007	The results of the experiments indicate that papaya fruit and betel nut are efficacious when fed at rates of both 533 and 1070 gram/10kg body weight for 5 days and 4g/10kg pig liveweight respectively.
1.2	Efficacy and growth rate experiments	Efficacy and growth rate experiments	March 2008	Completion delayed due to high cost of pigs as a result of pig shortage following CSF outbreak. Faecal egg counts in pigs fed both papaya fruit and betel nut were reduced to zero over the first 2 to 3 weeks of the trial (Figure 1 A and B), whereas faecal egg counts in pigs in group C increased weekly (Figure 1 A and B).

PC = partner country, A = Australia

7 Key results and discussion

Dose response experiments

The results for the dose response experiment indicated that both whole papaya fruit and betel nut have anthelmintic properties and reduce worm egg counts significantly following feeding to pigs.

The data indicates (Table 3) that papaya fruit and betel nut are efficacious when fed at rates of both 533 and 1070 gram/10kg body weight for 5 days and 4g/10kg pig liveweight respectively. However, pigs had difficulty eating the larger quantity of papaya fruit. Similarly betel nut was effective against *Ascaris suum, Trichuris suis* and *Strongyles.* However, it appeared to be ineffective on an on-going basis against *Strongyloides sp.*

Following artificial infection of pigs only significant numbers of Trichuris and Ascarid parasite egg were recorded. However, faecal egg counts in pigs fed both papaya fruit and betel nut were reduced to zero over the first 2 to 3 weeks of the trial (Figure 5 A and B), whereas faecal egg counts in pigs in group C increased weekly (Figure 5 A and B). Three of five pigs in group C died during the 4^{th} and 5^{th} weeks of the trial and it was decided to treat the remaining two pigs in the 8^{th} week. This was considered necessary on animal welfare grounds. Pigs in groups A and B were maintained until the end of 12^{th} week when faecal egg counts were still zero.

Pigs in group A grew at 82 ± 5.40 and 92 ± 6.34 g/day over an 8 and 12 week period (Figure 6), while pigs in group B grew at 71 ± 9.46 and 82 ± 6.34 g/day over the same periods (Figure 6). Pigs in group C lost weight (-27 ± 13.2 g/day) over the 8 week period and were then removed from trial on animal welfare grounds (Figure 6). Pigs in groups A and B continued to gain weight until the end of the trial.

However, while papaya fruit and betel nut had similar efficacies for the reduction of faecal egg counts, betel nut was more sustainable based on availability and ease of treatment.

Betel nut was a once weekly treatment using a smaller quantity of product, whereas papaya fruit required daily preparation and was not as plentiful in the Baliem Valley.

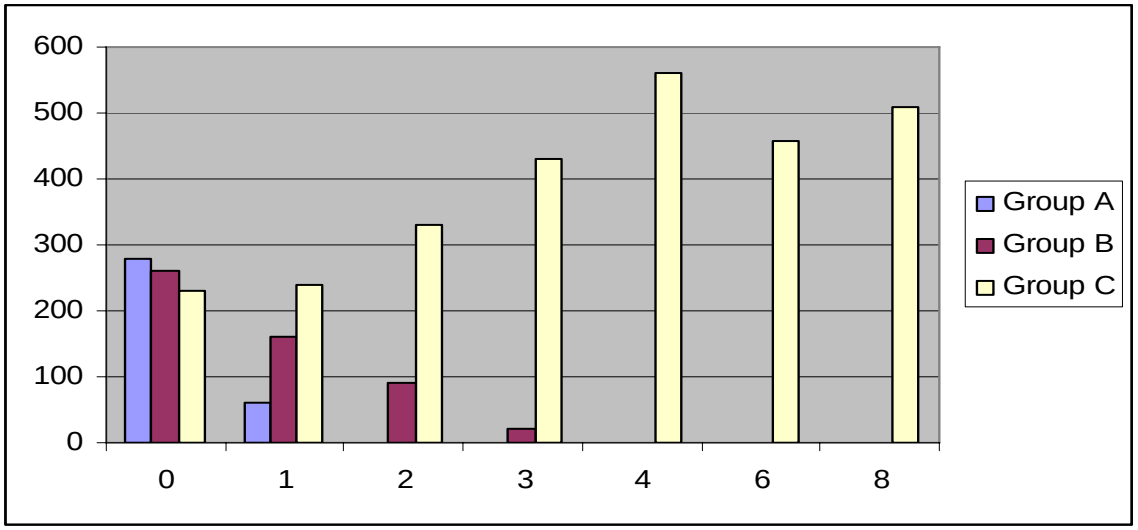
Table 3: Faecal egg count reduction (FECR) after treatment with whole chopped papaya fruit and betel nut powder

	6 days after treatment				**13 days after treatment**			
Parasite	Asc	Tric	Strgl	Strgs	Asc	Tric	Strgl	Strgs
Papaya								
400 ga	27.7%	1.4%	*	100%	38.0%	7.6%	*	0%
800 ga	55.2%	86.7%	44.4%	96.5%	97.9%	88.6%	100%	82.8%
1600 ga	78.7%	75%	100%	95.5%	100%	100%	100%	100%
Betel								
15g/50kg	4.5%	42.5%	100%	100%	0%	31.3%	100%	0%
20g/50kg	51.2%	86.5%	*	100%	100%	100%	*	0%

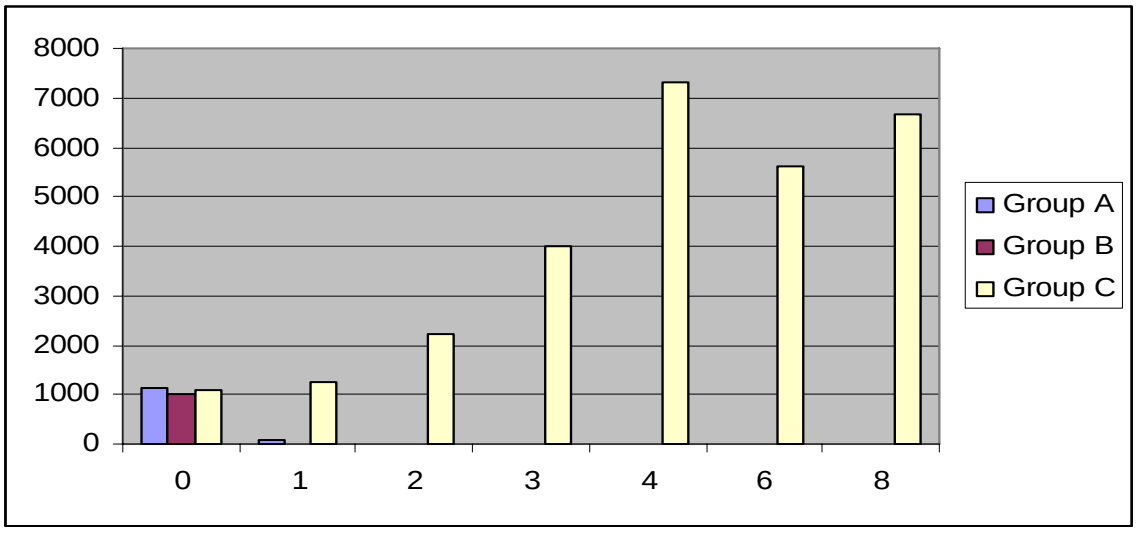
Asc *– Ascaris suum;* ***Tric*** *– Trichuris;* ***Strgl*** *– Strongyles;* ***Strgs*** *– Strongyloides*
a = g chopped papaya /15 kg body weight
** = insufficient egg counts pre-treatment for data to be valid*

Figure 5: Group data for Trichuris and Ascarid eggs

A: Trichuris eggs/gm faeces from Day 0 to day 56

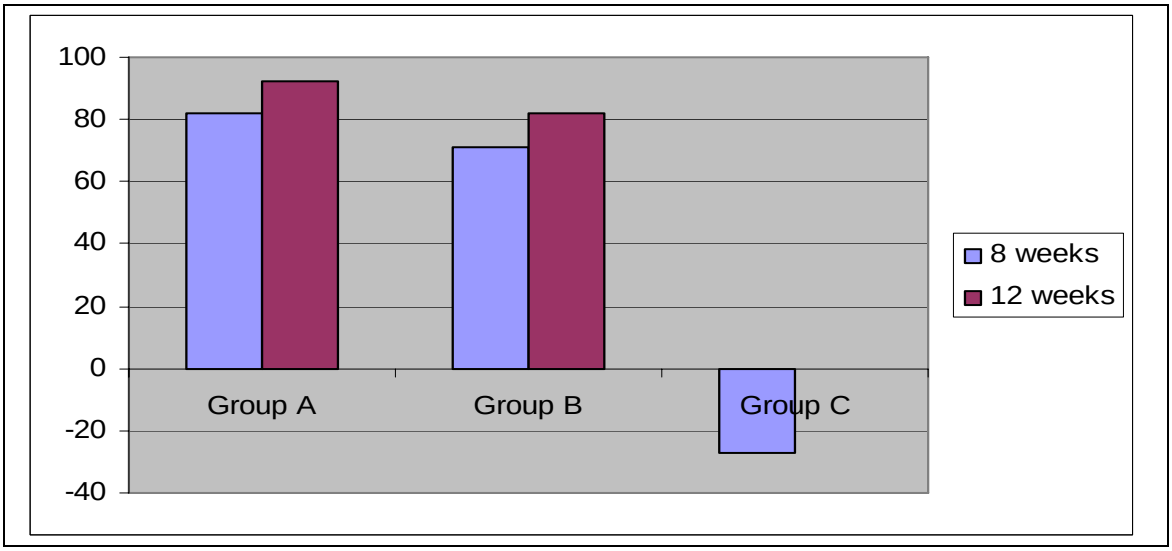


B: Ascarid eggs/gm faeces from Day 0 to day 56



Group A = 4 g betel nut / 10 kg pig once/week; Group B = 533g papaya fruit /10kg body weight/day for 5 days/week; Group C = no treatment

Figure 6: Average daily gain (g/day) for pigs in Groups A, B, and C 8 and 12 weeks after first treatment (Note group C removed at 8 weeks)



8 Impacts

8.1 Scientific impacts – now and in 5 years

The major scientific impact is the validation that feeding either papaya fruit or betel nut to pigs will reduce internal parasite burdens in pigs. This provides an option for farmers in areas such as the Baliem Valley where commercial pharmaceuticals are either too expensive or not available.

8.2 Capacity impacts – now and in 5 years

The only capacity impacts were limited to staff training in the design and execution of experiments to determine dose response and validate efficacy of possible medicinal plants.

8.3 Community impacts – now and in 5 years

Few community impacts are expected either now or in 5 years, other than enabling formers to produce healthier pigs.

8.3.1 Economic impacts

The major economic impact will come from healthier faster growing pigs and reduced mortalities. Based on pig prices in the Baliem Valley in 2006, prior to the outbreak of Classical Swine Fever, pigs in treated groups at the end of the trial were valued at 7.5 and 6.5 million rupiah respectively (approximately AUD$ 935 and AUD$ 812). Whereas, the value of the surviving pigs in the untreated group was only 1.6 million rupiah (AUD$200), a deficit of $600 dollars, or AUD$120/pig. By comparison the cost of treating pigs with betel nut was approximately 13,000 rupiah/4 week treatment program (AUD$1.60) and 51,000 rupiah/4 week treatment program (AUD$6.30). Hence supplementing diets with either papaya fruit or betel nut will enable farmers to sell more pigs from the same number of sows, thus increasing returns without increasing herd size.

The major problem with papaya fruit is that it is not a popular crop in the Baliem Valley and would have to be airfreighted in from coastal areas, to make its use sustainable. Betel nut on the other hand is grown locally as well as imported in large quantities for human consumption. Hence it is cheaper and more available for farmers to use and the small amount used to treat pigs does not compete with human consumption.

8.3.2 Social impacts

No specific social impacts are expected other than increased cash flow for farmers who take up this option.

8.3.3 Environmental impacts

No environmental impacts are expected.

8.4 Communication and dissemination activities

The information is being disseminated to the local community via a farmer to farmer training program which is part of ACIAR Project AS1/1998/054 - Poverty alleviation and food security through improving the sweet potato-pig systems in Papua Indonesia.

The initial and preliminary results have already been presented at two scientific meetings, one in Jayapura, Papua Indonesia and one in Malaysia (see publications).

9 Conclusions and recommendations

9.1 Conclusions

Supplementing pig diets with either papaya fruit or betel nut provides a viable alternative to using commercial parasiticides to control and eliminate the negative effects of internal parasitism in growing pigs.

9.2 Recommendations

Further investigation of the efficacy of both papaya latex and seeds when fed in isolation is warranted. If seeds were found to be as efficacious as latex, then seeds could be harvested from papaya used for human consumption and fed to pigs.

Further investigation into the practicality of preventing endoparasitism developing in unweaned pigs through sow treatment is required. If validated, this would provide a mechanism for producing parasite free weaner pigs in small holder production systems.

10 References

10.1 References cited in report

Damriyasa, IM., Cargill C., and Putra, IM (2005) Survey of endoparasite infections of pigs in Jayawijaya, Papua Indonesia. Meeting of the World Association for the Advancement of Veterinary Parasitology, Christchurch, New Zealand.

Putra, I M., Cargill, C., Damriyasa, IM., Putra, A.A., Kossay, L., Mahalaya, S., Tiffen, W and Peters, D. (2004). Survei Penyakit Babi di Kabupaten Jayawijaya, Papua, Indonesia. Dalam Limbongan, J., Y. Sujitno, N.E. Lewaherilla, A. Malik dan M. Nggobe (Eds.). 2004. Prosiding Seminar Nasional Teknologi Pertanian Balai Pengkajian Teknologi Pertanian Papua: Jayapura, 5-6 Oktober 2004. Pusat Penelitian dan Pengembangan Sosial Ekonomi Pertanian (PPPSEP), Bogor, Indonesia. Hal. 371-375.

Satrija, F., P. Nansen, S. Murtini, and S. He. 1995. Anthelmintic activity of papaya latex against patent *Heligmosomoides polygyrus* infections in mice. Journal of Ethnopharmacology, 48 (3): 161-164.

10.2 List of publications produced by project

Syahputra, A. T., Damriyasa, IM., Putra, IM., Mahalaya, S., Kossay, L., and Cargill, C. (2007) Improving the efficiency of the sweetpotato-pig production in Jayawijaya Regency of Papua Province: Reducing parasite infections in pigs. *Commonwealth Veterinary Association Journal* 23 (2): 5-9.

Syahputra, A. Triono, Damriyasa, IM, Putra, IM, Mahalaya, Sukendra, Kossay, Luther and Cargill, Colin (2007) Improving the efficiency of the sweetpotato-pig production in Jayawijaya Regency of Papua Province: Reducing parasite infections in pigs Dalam Limbongan, J., Y. Sujitno, N.E. Lewaherilla, A. Malik dan M. Nggobe (Eds.). 2004. Prosiding Seminar Nasional Teknologi Pertanian Balai Pengkajian Teknologi Pertanian Papua: Jayapura, 5-6 Oktober 2004. Pusat Penelitian dan Pengembangan Sosial Ekonomi Pertanian (PPPSEP), Bogor, Indonesia. Hal. 371-375.

Gray, G.D., M. R. Knox and C. Cargill (2007) Helminth control using local resources in smallholder production systems of Asia

11 Appendixes

11.1 Appendix 1

Wamena #2 diet

- 33% cooked SP-vines + 22% cooked SP roots + 34% ensilaged SP tubers and vines + 11% cooked banana trunk.
- The ensilaged material contained 85 kg SP roots + 15 kg SP-vines + 0.5 kg salt and was fermented for 14 days.