



World Vision



International Conference on Acacia species for Food Security and Environmental Rehabilitation in the Dryland Areas of Northern Ethiopia

Organized by:

Tigray Agricultural Research Institute and World Vision Ethiopia & Australia

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Preface

The Tigray Agricultural Research Institute (TARI) in Ethiopia has been implementing World Vision Australia Funded project in collaboration with world vision Ethiopia and other national and region partners. The Project entitled as “**Acacia Species for Food Security and Environmental Rehabilitation in the dryland areas of Northern Ethiopia**” has been implemented since March 2010 mainly in three districts of eastern zone namely *Kiltew-Awlaelo*, *S/Tsaeda –Emba* and *Atsbi-Wemberta* to contribute to the efforts underway to improve food security and environmental rehabilitation situation in the dry land areas of Northern Ethiopia. The project objectives were mainly to address the role of Australian acacias in general and *Acacia saligna* in particular for rehabilitation of degraded drylands, food and feed security and capacity building and awareness creation on the species multi-service functions and benefits. *Acacia saligna* has been introduced to Tigray region for environmental rehabilitation purposes in 1980s and planted extensively since 2000 and has not exhibited any signs of weediness. Currently, this species is being recognized as a multipurpose tree species mainly since the inception of this project and demonstrated its future potential ability for food security, agroforestry promotion and also enabling the community to adapt the changing climate. Accordingly, based on the three years research outputs and other countries experiences, TARI in collaboration world vision has organized this international conference with the following main objectives and expected outputs/outcomes.

Conference Objectives

1. To share and review research outputs of *Acacia saligna* tree and set modalities of their scaling up mechanisms and strategies
2. To exchange knowledge and experiences on the contribution of Australian Acacia species to the efforts underway to improve food and feed security and adapt to the changing climate
3. To facilitate and strengthen the collaboration between governmental and non-governmental organizations for the completion of Acacia seed food safety and human volunteer trials through officially approved procedures for its use as a human food
4. To synthesise ideas that help to formulate a new proposal to complete the ongoing and remaining research activities of the project and scale up successful findings

Expected Conference Outcomes/outputs

1. Well informed participants on the value and potential role of Australian acacias in general and the multipurpose benefits and services of *Acacia saligna* in Tigray, Ethiopia
2. Experiences shared among different countries and concrete commitments developed to ensure that action will be taken for further development and promotion of Australian Acacias as a strategy for food security and climate change adaptation and mitigation

3. Synthesized ideas (gaps and opportunities) for formulation of a new proposal to complete the ongoing and remaining research and development activities
4. Modalities set out on how to scale up identified technologies of *A. saligna*
5. Partner institutions identified and their collaboration strengthened to work together on Acacia seed safety and human volunteer trials and official approval granted for dissemination and promotion of the seeds as human food.
6. Published proceeding of the conference for wider distribution and networking

World Vision Ethiopia, TARI as implementing organization and the Acacia project team members' including world vision staff of Tigray would like to express their in-depth appreciation and acknowledgment to the funding organization (World vision Australia), the community particularly the Farmers Research Group (FRG) members' involved in the project implementing activities, the offices of agriculture in each project implementing districts and the regional bureau of agriculture for their overall facilitation and support, the Ethiopian Health and Nutrition Research Institute, and Melbourne University for their active involvement in research activities and support, Mekelle University for its involvement in capacity building of graduate students and the ministry of agriculture for its overall facilitation in import permits. Special thanks and acknowledgment will also goes to the Australian World vision team (Tony Rinaudo., Peter Cunningham, and Peter Yates) for their overall guidance and active involvement in all endeavors of the project (project development, technical backstopping, conducting research, preparation of this international conference). A great appreciation will goes for those coming from Australia, Kenya, Uganda and Chile supporting their own expenses to participate in this important conference and share their knowledge and experiences.

Acacia Project Base line Survey

Acacia saligna for food security and Environmental Rehabilitation

1. Socioeconomic Baseline Study of Acacia Project Pilot Districts Households

Abstract

A study was conducted in eastern zone of Tigray national regional state focused on assessing the socioeconomic baseline status of the three acacia project pilot districts (Kilte-Awlaelo, Atsbi-wonberta and Saesi-tsaedaemba). To accomplish these tasks formal and informal data collection tools of both primary and secondary data were used. A survey was conducted in the districts in which data was collected from randomly selected 180 households using a structured questionnaire. From the sample respondents, 78.3% are male-headed and the rest 21.7% are female headed households. The average age of the households is around 45 years with education level of 53% illiterate and 15.3% are literate to read and write. The livelihood activities based on agriculture, which is mixed crop-livestock production system. Crop production covers majority of the income of the households next to crop livestock production and products are the important source of income. Safety net income holds the greater share among off farm income; followed by income from daily labor (wage). The total annual nonfarm/off farm income of the sample households is found to be 2644 ETB per household. The average annual income from crop production is found to be 5272 ETB and the total annual livestock income is also 2270 ETB per household. Seemingly, the total annual income from tree/fruit is found to be 527.4 ETB. Generally, the total average annual income of three district farmers is found to be 11740.05 ETB per household. As to the awareness of the farmers on the tree acacia saligna, almost every farmer knows the tree acacia saligna as 99% of A/wonberta district, 100% of K/awlaelo and 100% of T/tsaedaemba district households respond. The farmers know the tree before 14 years and they pointed out as they get the information from BoARD, observation, other farmers, NGOs and neighbors. In addition to in communal and gullies acacia saligna is planted around homestead of the households as 62% of the total sample respondents planted acacia saligna so far. Farmers was planted the tree around homestead (86.6%), farm land (4%) and communal land (4%), moreover, about 60% of the farmers observed as there is variability within the different species of acacia saligna, 24% did not observe any variability/difference. Based on the study findings, about 71% of the households as acacia saligna have best qualities as compared to other trees on its better survival rate, fast growing and drought resistance. This indicates the tree can survive in drought prone and rainfall deficit areas with low investment and less management. There is an experience of using acacia saligna as animal feed in the seasons where there is no enough feed/dry seasons. About 63.7% of the sample households use the tree leaf for their animal feed, moreover; larger proportion of A/wonberta (76%) and S/tsaedaemba (82%) households utilize acacia saligna as feed whereas, only 19% of K/awlaelo households have the experience of using acacia saligna as feed. Majority of the farmers (84%) use this feed during March, April and May as these months are feed scarce periods in the area. There is no experience of supplying acacia saligna feed by treating or processing they simply provide the green leaf of the tree as well as around 75% of the sample households whom use acacia saligna feed respond as they use green/fresh leaf. With regard to milk yield, 50% of them did not observe any change, 38% observe positive effect on milk yield and only 10% respond as it has no effect on milk yield. Of the total sample farmers about 56% of them pointed out as the acacia saligna feed have increased the body weight of their animals and only 17% have no observation whether it have negative or positive effect on body weight. As to the importance of the tree as bee forage, around 56% of the sample farmers recognize as it is important source of bee forage, 23% believe that the flower of acacia saligna in not important for bee production and the rest 21% of them did not know whether it is important or not for bee forage. It is not common to see people using acacia saligna for human food in

the areas where this project is going to be implemented. Moreover, majority the households have no awareness as acacia saligna can be used as human food, whereas, the households are ready to use the tree acacia saligna for human food in the future. To this end, it is important to create awareness, capacity building and demonstration of acaciasaligna for different purposes to utilize the potentials of the tree for food security and environmental rehabilitation. In addition to this, establishing effective producers and marketing cooperative; supply of improved agricultural technologies and strengthening the existing institutional support services is also found as crucial intervention points to improve the livelihood status of the rural households of the study districts.

Keywords: Acacia saligna, animal feed, income, bee forage and food value

Acacia saligna for food security and Enivironmental Rehabilitation

Theme 1: Food and nutrition Security

1. Experiences of Developing Acacia saligna Seed for Human Food: Processing Techniques for acute toxicology Experiment

1

Abstract

Farmers' observation for Acacia saligna seed to be consumed by wild animals in Tigray and experiences from West African countries of using other Acacia species for food revealed the possibility of developing Acacia saligna as a fortifying ingredient of protein poor cereals in Tigray. With the guided support from the Ethiopian Health and Nutrition Research Institute consecutive experiments and chemical analysis on processed and unprocessed Acacia saligna seed was done. During the initial chemical analysis of phytate and tannin insignificant amount of the anti-nutritional compounds were observed. Following this results a toxicology analysis was carried out on roasted and unroasted Acacia saligna seeds. The result of the analysis indicated better result for the roasted than the unroasted Acacia saligna seeds. As a next step to improve its food value through reduction of the anti-nutritional factors²⁴ acacia samples each 0.5 kg were prepared for HCN analyses at the Ethiopian health and nutrition research institute in Addis Ababa. In addition to this; another 24 kg of acacia samples one kg from each food treatment were prepared for acute toxicology analysis which run from 12/07/2012 to 01/08/2012. The treatments were Grinding, Roasting, Boiling, Fermentation, Germination and Heat treatment along with different time intervals. Four kg were allocated for each the six processing methods. All the 24 samples were roasted in laboratory and ground through the traditional mortar and piston. Hydrogen cyanide was found to be 3ppm which is below the WHO standard 20ppm. Results of most of the processing methods for the acute toxicology test indicated toxicity of Acacia saligna seed however some of the processing methods such as roasting for 20minutes showed none toxic effect on the experimental animals, with decreasing toxicity as time of roasting increased from 5-20minutes. Moreover, the level of effect was variable among the treatment methods and duration of treatment. It is therefore concluded that, it is advisable not to use Acacia saligna as human food before determination of the specific anti nutritional factor and its appropriate processing technique.

⁴Ethiopian Health and Nutrition Research Institute, Addis Ababa, Ethiopia

2. Non-protein amino acids in Australian acacia seed: Implications for food security and recommended processing methods to reduce djenkolic acid

Authors: Boughton, B; Yates, P; Reddy, P; Boland, MP; Roessner, U.

Abstract:

Seed of several species of Australian acacia were analysed for non-protein amino acids using mass-spectrometry techniques. Djenkolic acid was found to be present in all species tested. The lowest levels were in *A. colei* (0.49%) and the highest in *A. saligna* (1.85%). These levels of djenkolic acid are comparable to levels found in the djenkol bean, which has known toxicity issues. Subsequent testing of seed processing methods showed that djenkolic acid levels can be reduced by over 90% by dry roasting at 180°C, which should render the toxin levels negligible.

3. A sub-acute acacia seed feeding trial

Authors: Yates, P; Featherby, T; and Birchall, I.

Abstract:

This 14 day sub-acute in-vivo study investigated the safety of Australian acacia seed as a food, and sought to confirm that djenkolic acid is an active toxin in the seed. Ten cohorts of ten rats each were used (n=100). Six cohorts were fed diets supplemented with seed of *A. colei*, *A. torulosa* or *A. saligna*, at either 30% or 60% of diet. Three cohorts were fed a standard rat chow laced with synthetic djenkolic acid at three different levels. A control was fed rat chow alone. Daily observations were made of food and water consumption, weight, and general health. At the conclusion of the trial all animals were euthanised and the liver and kidneys removed for histological examination. No signs of ill health were observed and no significant association was observable between kidney abnormalities in the test cohorts and the control. The study concludes that properly processed acacia seed at up to 50% of diet causes no health effects over a 14 day period. Further trials including a chronic (90 day) trial, and a human volunteer trial (21 days) will be necessary before the acacia seed species tested can be considered safe for long term human consumption.

4. Production of functional foods with seeds of *Acacia saligna*

Patricio Rojas Vergara¹

SUMMARY

There are 7.500 hectares of *Acacia saligna* in the dryland of the Coquimbo Region for the protection of soil and forage production marginally, whose seeds could be processed for the production of functional foods and healthy meals. There is information on the nutritional value of *Acacia* seeds for edible purposes as biscuits whose products and flavours are preferably intended for industry of functional foods and nutraceuticals bushfood in Australia, with high profitability for seed producers. This market niche includes natural products with beneficial health properties such as high protein, rich in fibre content of their meals and low glycemic index. The new line of products to be developed by the project (that include La Estampa flour mill) considered an multigrain bread and a biscuit with functional properties for health.

Project activities have focused on two important aspects for business:

- a) **Develop the economic feasibility of the production of flour mixtures with functional components.**
The first part of the study considers the analysis of profitability for the forest manager whose goal is to fully allocate their plantation for seed production under different scenarios sensitivity analysis which considers the following: a) planting density, b) seed production c) variable costs, d) fixed costs e) initial investment. The second part of the study considers the economic feasibility study at the Mill with pre-mixes flour made from *Acacia* seeds for the manufacture of biscuits and bread with an additive of 5% of *Acacia saligna* seeds.
- b) **Determine the feasibility of supplying the mill's with *Acacia saligna* seeds based on the available forest resources in the Region of Coquimbo.** For this purpose the CONAF databases were consulted in respect of existing plantations in Region IV which gives a total of 7,499 has planted that correspond to different size of small and medium landowners. The highest concentrations of the plantations are located in the Hacienda Tangué (Coquimbo) with 1,695 hectares.
- c) **To estimate the yield per tree and per hectare** in 76 circular plots (7.98 m radius) with a single area of 1/50 ha (200 m²) in 5 representative farms in the Region of Coquimbo. Processes of collecting fruit for cleaning and subsequent estimation of yield per tree and per hectare.

Main technical activities of first six months of the project are informed in this presentation.

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Acacia saligna for food security and Environmental Rehabilitation

Theme 2: Acacia species animal feed security

1. Evaluation of Nutritional Quality for different Botanical Fractions of *Acacia saligna* (Labill.) H.L. Wendl. as potential Ruminant Feed Supplement in Northern Ethiopia

Abstract

In Tigray Acacia saligna was introduced for the purpose of environmental rehabilitation and soil and water conservation. However, limited information is available on the utilization of the plant as livestock feed. Hence, the objective of this study was to assess the chemical composition of the Acacia saligna leaves, soft twigs and pods there by assess its potential as ruminant feed for four randomly categorized Acacia sub species. These are narrow leaved unique 1, narrow leaved unique 2, Barka A and Barka B. Plants were differentiated based on their physical difference on leaves, seed bearing, and vigorsity. Samples of Acacia saligna leaves, twigs and pods were collected from Illala, Mekelle and AtsbiWenbertadistrict and mixed for homogeneity and analyzed for chemical composition. The varieties had similar leaf DM whereas broad leaved (BL) and narrow leaved (NL) (4.69 % and 4.32%) showed higher ash content next to (deep green leaved 1) “Barka A” and (green leaved) “Barka B” (6.23% and 6.46%, respectively. But the narrow leaved unique 1(NLU1) and NLU-2 showed lower ash content (3.05 % and 3.65%) respectively. All the varieties had higher CP (19.36%-23.32%) above the CP (6%) maintenance requirement suggested for tropical legumes. The ash content of the twig part of the different varieties ranges from 4.73 % to 6.14%. The Barka A and Barka B have higher CP (9.12 and 10.11%) respectively comparing to the other varieties which is below the minimum requirement of CP (7%) for ruminant animals. The pods CP content of NL and BL was 13.43% and 14.08% respectively. The two varieties had similar NDF (42.57% and 40.83%) and ADF (23.84% and 23.06%) and lignin content of 6.89% and 6.16% respectively. The tanning content was higher in twigs followed by the leaves and pods. Generally, all the accessions and botanical fractions of Acacia saligna are potential sources of protein supplements to ruminants. However, higher crude protein content is indicated in the leaf part, followed by the pod and twigs.

Key words: *Acacia saligna*, animal feed, chemical composition and tannin

2. Effect of feeding treated *Acacia saligna* (Labill.) H.L. Wendl. Leaves on chemical composition, growth performance and digestibility in goats

Abstract

A study was conducted to evaluate the effect of air drying, water and wood ash solution soaking of *Acacia saligna* leaves in deactivating the condensed tannin content, nutrient intake, live body weight gain, and digestibility in Abergelle intact male goats. The goats were grouped according to their initial body weight (16 ± 2.47) in a randomized complete block design into four treatments. Treatment one (T1) included only grass hay as a control, 300 g head⁻¹ day⁻¹ air dried (T2), 300 g head⁻¹ day⁻¹ water soaked (T3) and 300 g head⁻¹ day⁻¹ wood ash soaked (T4) were offered to Abergelle goats. Dry matter intake was measured daily, while live weight gain was recorded weekly. A 7-day digestibility trial followed the feeding trial where faeces and urine were collected. Proximate analysis showed that crude protein content was 12.1, 10.6 and 11.2 and 7.9% for the air dried, water soaked, wood ash soaked *A. saligna* leaves and grass hay, respectively. Condensed tannin content for the air dried, water and wood ash solution soaked *A. saligna* leaves was 18.7, 11.2 and 8.2 g kg⁻¹, respectively. Average daily live weight gain for the supplemented goats ranged from 21.9-34 g day⁻¹, the highest being recorded in goats provided with the air dried *A. saligna* leaves. The highest nutrient digestibility was measured in the supplemented goats and ranged from 47.4 to 68%. Goats fed on air dried and wood ash solution soaked *A. saligna* leaves had a positive N balance and goats maintained on native grass hay alone and supplemented with water soaked *A. saligna* leaves had a negative N balance. But it can be concluded that air dried *A. saligna* leaves can be effectively used as a protein supplement for goats due to higher body weight gain and economic gain.

Keywords: Abergelle goat; body weight gain; N balance; tannin.

3. Body weight change and carcass characteristics of Abergelle goats supplemented with fixed level of *Acacia saligna* (Labill) H.L.Wendi. Leaves treated with air drying, water and wood ash solutions fed grass hay as basal diet

Abstract

*A study was conducted to evaluate the effect of feeding fixed level of treated *Acacia saligna* leaves (ASL) on feed intake, live body weight change and carcass characteristics of Abergelle goats by deactivating the detrimental effect of ASL. The experiment was executed in Aberegelle Agricultural Research Centre goat farm in the northern Ethiopia. Four treatments namely grass hay as a control, air dried *A.saligna* leaves (ADASL), water and wood ash soaked *A.saligna* leaves each included at 300 g head⁻¹ day⁻¹ were used as supplement. Feed intake was measured daily and live weight gain recorded weekly. Measurements were taken on empty body weight (EBW), hot carcass weight (HCW), dressing percent (DP) and rib eye muscle area (REMA). Higher total crude protein intake was observed in the supplemented goats as compared to non-supplemented. As a result, better body weight gain was observed in the supplemented goats as compare to non-supplemented goats. Similarly, better HCW was obtained in the supplemented goats than non-supplemented in general and in particular goats fed on T2 and T3 received significantly higher HCW than the T1. So that it is important that ASL to be used as alternative feed particularly at the time of feed scarcity. However, DP on slaughter weight base (SWB), EBW base and REMA were not showed any significant different among the treatments. Generally, goats supplemented with ADASL showed higher body weight gain and carcass value compared with the other treatments. In this treatment, it is also observed higher economic benefit than the other treatments due to higher body weight gain and lower cost of the feed.*

*Key words: Abergelle goat; *Acacia saligan* leaf; Carcass parameter; Weight gain*

4. Effect of utilization wheat bran and dried *Acacia cyanophylla* Lindl. leaves as highland sheep ram feed and its economic feasibility

Abstract

This study was conducted with the following objectives: (1) To evaluate the nutrient contents of the grass hay, A. Saligna and wheat bran; (2) To evaluate body weight gain, feed intake and digestibility of highland sheep supplemented with wheat bran and different graded level of dried A. Saligna leaf; (3) To evaluate the nitrogen balance of highland sheep supplemented with wheat bran and Acacia saligna and (4) To determine the cost benefit ratio of highland sheep supplemented with wheat bran and Acacia saligna. The research was carried out at Mekelle Agricultural Research Centre (MARC) in 2011/12 using twenty rams. Five treatments namely grass hay as a control (T1), 100 grams per day Acacia saligna, (T2), 200 grams per day A. Saligna (T3), 300 grams per day A. Saligna (T4) and 400 grams per day A. Saligna (T5) with the addition of 200 grams per day of wheat bran for the supplemented treatment was provided to the experimental units lasted for a period of 90 days. Faeces and urine were collected at the end of the 90 day experiment and following three days of adaptation for the faecal collection bag and cage for urine collection seven days data were collected and analyzed in order to evaluate digestibility and nitrogen balance. The rams were grouped according to their initial body weight in a randomized complete block design (RCBD), Feed offered and refused were recorded daily and body weight measured every week. Rams in the control group gained 7.78 g/day but not comparable to 42.78, 63.89, 62.22 and 57.78 g/day for T2, T3, T4 and T5, respectively. There was a significance difference ($P < 0.05$) between the supplemented and control group except for T2, which was numerically higher by 70% from T1. Thus, supplementation of 200 g/day dried A. Saligna and 200 g/day wheat bran is biologically more efficient and economically more profitable and thus recommended for highland sheep ram fattening.

Key words: Highland sheep, Acacia saligna, Digestibility and Grass hay

5. Effect of supplementing dried *Acacia saligna* leaves and wheat bran on meat characteristics and sensory quality of highland sheep rams meat

Abstract

*The objective of this study was to study body weight gain and carcass characteristics of highland sheep and to evaluate sensory quality of the meat from highland sheep rams (HSR) fed on grass hay and supplemented with dried *Acacia saligna* and wheat bran. The study was carried out at Mekelle Agricultural research Center in 2011 to 2012. 20 highland sheep rams at a yearly age were grouped the first, second, third and fourth block included rams with an initial body weight from 23.4 to 25.2 kg, 22.0 to 23.0 kg, 21.4 to 22.2 kg and 19.0 to 20.2 kg, respectively. Treatment feeds T1, T2, T3, T4 and T5 were T1, control; T1, 100 g of air dried *Acacia saligna* leaves and 200 g wheat bran; T1, 200 g of air dried *Acacia saligna* leaves and 200 g wheat bran; T1, 300 g of air dried *Acacia saligna* leaves and 200 g wheat bran; and T1, 400 g of air dried *Acacia saligna* leaves and 200 g wheat bran, respectively. Carcass weight was a significant difference ($P < 0.05$). Dressing percentage of T1, T2, T3, T4 and T5 was 39.86, 43.79, 43.75, 41.53 and 44.38, respectively. Supplementation of dried *Acacia saligna* and wheat bran doesn't have an impact on sensory quality of HSR meat rather it improves the carcass weight that fetch better income to the producers.*

Key words: Carcass, grass hay, dressing percentage, Tigray, Ethiopia and organoleptic quality.

6. Effect of feeding dried *Acacia saligna* leaf on reproductive performance of highland sheep rams

Abstract

The study was carryout with an objective of evaluating reproductive performance of highland sheep rams (HSR) supplemented with dried *Acacia saligna* and wheat bran. It was undertaken in Mekelle Agricultural Research Center (MARC) with 20 yearly HSR grouped in to four blocks. Each block hold five HSR based on their initial weight. The HSR randomly assigned to the five treatment diet within the block. Treatment diets were T1, T2, T3, T4 and T5; T1, provide free choice to grass hay without supplementation (control); T1, 100 g of air dried *Acacia saligna* leaves and 200 g wheat bran; T1, 200 g of air dried *Acacia saligna* leaves and 200 g wheat bran; T1, 300 g of air dried *Acacia saligna* leaves and 200 g wheat bran; and T1, 400 g of air dried *Acacia saligna* leaves and 200 g wheat bran, respectively. The evaluation of semen quality characteristics was undertaken for all experimental rams except those who unable to ejaculate. Scrotal circumference, libido character and body condition were measured. However, at the end the evaluation of reproductive performance all of the HSR were slaughtered and evaluated for scrotum weight. Semen volume and mass motility was significantly different ($p < 0.05$) between control (T1) and supplemented treatments T3, T4 and T5 than T1. However, T1 and T2 were not significantly different in semen volume and mass motility but T2 was numerically higher than T1. Feeding of *Acacia saligna* doesn't affect HSR live and dead count and percent of the sperm cells. Supplementation of dried *Acacia saligna* leaf and wheat bran to HSR beside of improving their body weight it also improves the reproductive performance of the HSR. Hence, HSR producers should supplement their rams for effective reproduction of their herd.

Key words: Libido, MARC, Semen volume, Body condition and Highland sheep rams.

7. Effect of Seed Treatment on the Nutritive Value of *Acacia saligna* (Labill.)H.L. Wendl Seed in Tigray, northern Ethiopia

Abstract

An experiment was conducted to determine the effect of seed treatment methods on the chemical composition of Acacia saligna seeds. The seed treatments were raw, soaked with water for 13 hrs. and boiled for 5 minute, and roasted at 100°C for 3 minutes. There were non-significant ($p > 0.05$) difference among the seed treatment methods in CP, EE, CF, NFE and ash content of the seed. However, there was significant ($p < 0.05$) difference among the seed treatment methods in their DM content. The DM content of roasted seeds was higher (93.73%) than the raw (90.83%) and soaked (91.27%). Raw Acacia saligna seeds were composed of 28.16% CP, 15.51% EE, 14.43% CF, 36.81% NFE and 5.1% ash; 28.41% CP, 14.51% EE, 13.33 CF, 38.51% NFE and 5.24% ash for soaked seed, and 28.28% CP, 15.12% EE, 15.28% CF, 35.78% NFE and 5.58% ash for roasted seed. The average tannin content was 52.50, 49.84 and 32.20 mg/100g for raw soaked and roasted seeds respectively. Whereas, the average phytate content was 82.80, 81.60 and 13.20 mg/100g for raw, soaked and roasted Acacia saligna seeds. The highest tannin and phytate content reduction was observed in roasted as compared to soaked seed. Therefore, Acacia saligna seeds were potential in their chemical composition and can be incorporated in animal feeding with proper roasting and soaking methods.

Key words: Seed treatment, Acacia saligna seed, phytate, tannin

8. Effect of feeding raw and processed *Acacia saligna* (Labill. H. Wendl) seed on productive performance and carcass parameters of broilers in Tigray, northern Ethiopia

Abstract

The experiment was conducted to determine the productive performances and carcass parameters of broilers fed raw and processed *Acacia saligna* seed meal. A total of 330 Cobb 500 unsexed day old broiler chicken were used for the experiment. The birds were randomly allocated to ten dietary treatments in a completely randomized design with three replications containing 0%, 5%, 10% and 15% raw, soaked and roasted *Acacia saligna* seed meal for 33 birds each. The mean daily dry matter intake showed significant ($p < 0.05$) difference among treatments. The birds at starter, finisher and overall entire experimental period ranged 28.53-39.75 g/bird, 45.05-101.08 g/bird and 36.44-66.03 g/bird, respectively. The daily dry matter intake was higher for birds fed T2 (66.03 g/bird), T1 (65.02 g/bird) and T5 (60.14 g/bird) but lower for T9 (36.44 g/bird) and T10 (37.32 g/bird) in the entire period. However, the daily weight gain of the birds showed non-significant ($p > 0.05$) difference in the finisher phase ranging (13.13-23.05 g/bird) and entire experimental period (11.69-17.49 g/bird) except the starter phase (7.83-13.08 g/bird) which showed significant ($p < 0.05$) difference among treatments. The dry matter efficiency ratio (DMER) showed significant ($p < 0.05$) difference among treatments in the starter, finisher and the overall experimental period. The highest DMER was recorded for T3 (0.35), T6 (0.35), T8 (0.35) and T9 (0.34) but the lowest was T2 (0.25), T1 (0.26) and T5 (0.29). The carcass characteristics of the birds also showed non-significant ($p > 0.05$) difference among treatments and this indicates utilization of *Acacia saligna* seed in broiler diet had no adverse effect on the carcass parameters. Therefore, *Acacia saligna* seed needs soaking and roasting at the inclusion levels of 5% to be economically feasible for broiler diet.

Key words: Dry matter efficiency ratio, weight gain, dry matter intake, soaking, roasting

9. Enhancing Economic Benefit of Smallholder farmers through Dried *Acacia saligna* Leaves and Wheat bran supplementation of Tigray highland sheep in northern Ethiopia

Abstract

Following a feeding trial on sheep the best level of Supplementation was recommended to be practiced by the small holder sheep keeper around the potential Acacia saligna growing areas of Tigray, Northern Ethiopia. The study was carried out with the objective of scale up/out the best supplementation practice of dried Acacia saligna (DAS) leaves and wheat bran (WB) to highland sheep rams (HSR), to evaluate body weight gain of HSR supplemented with DAS and WB at farm level, to establish linear body measurement of HSR and to evaluate cost benefit analysis of the feeding practice. The study was carried out at Atsbi-Wemberta, Wukro-Kilte-Awlaelo and SaesieTsaedaEnbaWeredas of Tigray. A total of 120 farmers were included and 240 sheep were part of the study. The treatments were farmers practice (grazing only) and farmers practice + 200 g/ day DAS + 200 g/day WB. The crude protein content of DAS and WB was 14.84 and 16.20, respectively. The live weight gain for HSR is 59.2 and 19.49 g/day for the supplement and control group, respectively. Higher daily weight gain of rams achieved at Abrha-Atsbeha 86.76 g d⁻¹ followed by 70.29 g d⁻¹ Hayelom. Rams in Mariam-Agamet and Barka-Adi-Sibha also exhibited body weight gain of 46.14 and 35.45 g d⁻¹, respectively. The supplemented group also exhibited significant difference ($P < 0.05$) before and after the supplementation in heart girth, height at withers, body length and weight change. The financial recompense obtained from the supplement and control is positive but higher return was obtained from the supplemented rams than the control. Therefore, supplementation of Acacia saligna at the level of 200 g/ day DAS with 200 g/day WB is profitable for sheep fattening.

Key words: *Acacia saligna*, Atsibi Sheep, Supplementation and Body weight gain.

10. The value of *Acacia saligna* for beekeeping industry and the importance of *ApisMelifera* L. to *Acacia saligna* seed yield and quality

Abstract

Ethiopia's wide climatic and Edaphic variability have endowed this country with diverse and unique flowering plants thus making it highly suitable for sustaining large numbers of bee colonies and the long-established practice of beekeeping. The local honeybee plants are very good source of nectar and/or pollen. There are also exotic honeybee forages which serves as a source of nectar and/or pollen. From the exotic honeybee forages *Acacia saligna* is the one which was not recommended by some of the beekeepers and extension workers in the region. This piece of work was done see the contribution of *Acacia saligna* for beekeeping industry and honey production in Tigray. The activities were pollen sorting and counting, pollen nutritional analysis and the contribution of managed honeybees (*Apis mellifera* L.) for *Acacia saligna* seed yield and quality. Results revealed that for sorting and counting pollen the highest result was for *Acacia saligna* (42.2%) and the lowest were unknown plants 0.25% and sunflower with 0.6%. With the nutritional content *Acacia saligna* accounts for 21.21% protein and *helianthus annuus* is 17.31%. Yield increments of *Acacia saligna* are: Seed weight with coat (g) = 94.81, Seed weight without coat (g) = 159.5 and Germination % = 2.899. Therefore, honeybees collect *Acacia saligna* pollen even there is availability of other pollen sources. The protein content of the plant is observed to be very good and recommended for honeybee. Moreover *Acacia saligna* pollen is regarded as very good protein source for hive building up. The results approved that utilization of honeybees would effectively increase *acacia* seed quantity and quality.

Keywords: Open pollination, *Acacia saligna*, Germination %, *Acacia* pollen

11. Effect of *Acacia saligna* on honeybee health and quality of honey

Abstract

Some beekeepers and extension workers in Tigray region had negative attitude on the contribution of Acacia saligna plant to honey quality. There was also a lot of complains raised from the farmers and extension workers on the immediate death of the honeybee in relation to the plant (Acacia saligna flower). To proof this, honey quality analysis (acidity, mineral ash content, water insoluble solids, moisture content, conductivity, total reducing sugar, sucrose content, Ph and hydroxymethylfurfural (HMF)) was done at Dimma bee keeping development and honey processing plc. Moreover, honeybee colony with eleven frames was caged in the Acacia saligna plant during 50% flowering stage. Continuous observation was done on the forager honeybee to see the effect of acacia on bee health. Field day was arranged to discuss with the farmers and extension workers at the two districts (AtsebiWonberta and WukroKilte-awulaelo). The average contents of Acidity, Mineral ash content, Water insoluble solids, Moisture content, conductivity, Total reducing sugar, Sucrose content, PH and HMF of honey samples were determined as 27.7 meq kg⁻¹, 0.2%, 0.0%, 18.1%, 0.4 mS/cm, 70.1%, 2.7%, 4.0 and 14.4 mgkg⁻¹ respectively. The results revealed that means for each biochemical component of the honeys from different origin were generally appropriate to European, Indian and Ethiopian standards in terms of all biochemical components. There was also no honeybee died due to acacia flower and no color change in the honey comb was observed.

Keywords: Biochemical, honey standard, eleven frames, and bee health

Theme 3: Acacia species for Environmental Rehabilitation and agroforestry development

Acacia saligna for food security and Environmental Rehabilitation

12. Domestication of *Acacia saligna* trees as Backyard Agro forestry system in Eastern zone of Tigray, Ethiopia

Abstract

Acacia saligna is a very adaptable and fast growing tree native to Western Australia. These attributes have led to its widespread distribution as an important species used extensively for soil stabilization, animal fodder, and a source of fuel wood in many countries around the world. The study was held in the eastern zone of Tigray in a specific Wereda's called SaesietTsaedaEmba, KilteAwlaelo and Atsbiwenberta with the objective of introducing and domesticating the tree as backyard agro forestry system while simultaneously evaluating its survival rate and growth performance at farmers' management level. Farmers who are heartily interested to participate in this research activity were selected as FRG and trained on how to prepare and manage pre and post plantation activities. Two weeks ahead, plantation pits which have 40cm by 40 cm dimensions were prepared by the FRG members. The top and sub soil of the pits were administered separately and later (during plantation) the top soil were let to be at the bottom of the pit followed by the subsoil. The total number of *Acacia saligna* seedlings planted in 2010 and 2011 at Atsbi_Wenberta, Kilte-awlaelo and SaesietTsaedaEmba Wereda's were 1921, 1875, and 2661 respectively. Supervision and inventory of seedlings survival rate was held every year and the collected data were analyzed by excel for descriptive statistical analysis. The two years average survival rate of planted *Acacia saligna* seedlings in Atsbi_Wenberta, Kilte_Awlaelo and SaesietTsaedaEmba Wereda's were 74.125%, 66.9% and 62.6% respectively. The overall mean survival rate was 67.875%. Generally, the survival rate of the planted *Acacia saligna* seedlings indicates that their natural mortality rate is low. However, if not properly managed at their seedling stage their mortality rate could be enhanced by animal trampling and browsing and this was also commonly seen as a problem in the study areas.

Keywords: *Acacia saligna*, Back yard Agro forestry, Survival rate, Growth performance.

13. Seed yield Determination of *Acacia saligna* in Tigray, Northern Ethiopia

Abstract

Acacia saligna is a hardy, fast-growing species that tolerates drought, water logging, light frost, alkalinity and salt (Simmons 1987). It is a multi-purpose tree relatively short-lived life span of about 10–20 years. The assessment was conducted in three districts of Northern Ethiopia Tigray, namely Kilte –Awlaelo, Atsibi-Wembert, Saessie-Tsaedaembe and Bizet in December 2012. The objective was to determine average seed yield per tree as well as seed yield potential of the sites. Based on our observation in the study area, *A. saligna* can flower two times a year. First from early October to late November and second round from late January to late February. But, this happens in Australia from late July to October (Maslin et al. 1998). Mature seeds are present between early December and mid-January and second round in late April to middle May. In the study area *A. saligna* sets moderately heavy seed. The mature pods were harvested manually from 6-10 year old, with average diameter 9.77Cm, height 4.77m and 4.89 m Crown width, by shaking/threshing, and the seeds readily detach from the mature pods. The study revealed that overall mean seed yield of *Acacia saligna* trees on the study area/Eastern Tigray/ is 1.028 kg per tree. There is a significance difference in seed yield per tree between Haykimeshal and Adishu sites at $P (0.05)$ but not with Bizet site.

Key words: *Acacia saligna*, enclosure, Seed yield, Northern Ethiopia

14. Population distribution and abundance of *Acacia saligna* in Tigray region

Abstract

Acacia saligna, or the Port Jackson willow, is a very adaptable and fast growing tree native to Western Australia (Midgely & Turnbull, 2003). These attributes have led to its widespread distribution as an important species used extensively for soil stabilization, animal fodder, and a source of fuel wood in many countries around the world (Midgely & Turnbull, 2003). The study was held in the eastern zone of Tigray in a specific Wereda's called Saesiet Tsaeda Emba, Kilte Awlalo and Atsbiwenberta with the objective of investigating the distribution, abundance and structure of existing *acacia saligna* stands. Transect line with a hundred meter (100m) spacing and 20 by 20 meter sample plots were taken from the transect lines at an arbitrary distances between plots. The number of sample plots taken from Kilte-Awlalo, Atsbiwenberta and Saesiet Tsaeda Emba were 80, 34 and 20 respectively. Different parameters of *acacia saligna* such as DBH, plant height, number of plants per plot, crown height, crown diameter and other species found in the plot were collected from three (3) representative stands *acacia saligna*. SPSS computer soft ware version 20 was used to analyze the collected data. ANOVA was used to see if there is stastical difference in number of trees per hectare between the different study sites. The average number of *Acacia saligna* stands per hectare in Kilte-Awlalo, Atsbiwenberta and Saesiet Tsaeda Emba was 385, 635 and 866 respectively. As the data was not normally distributed, Ln transformation was used and computed the statistical differences. No statistically significant difference ($p= 0.826$) in number of trees per hectare was obtained between Atsbi Wenberta and Saesiet Tsaeda Emba, but Kilte Awlalo is significantly different from Saesiet Tsaeda Emba ($p=0.016$) and Atsbi Wenberta ($p=0.027$). The mean number of stands per hectare of mature, sapling and seedlings of *acacia saligna* were 362, 70 and 88 respectively. Kruskal Wallis was used to evaluate the difference of population structure in the different study areas and no stastically significant difference in mature number of *acacia saligna* stands per hectare was obtained between Saesiet Tsaeda Emba (82.38) and Kilte Awlalo (78.85). Eventually, even though this is the statistical evidence generated from the collected data, it is difficult to conclude what makes the number of trees per hectare to be different between the study areas. This difference may be due to the variation in plantation or other soil and geographic factor.

15. Potential for *A. saligna* in Agroforestry farming systems in Tigray, Ethiopia.

Author: Peter. J. Cunningham

Abstract:

Edible, multi-purpose Australian acacias have shown significant potential to improve farm income and resilience in Agroforestry farming systems in Niger. Progress on the domestication, provenance evaluation, silvicultural requirements and potential for *A. saligna* in Agroforestry farming systems in Tigray, Ethiopia will be presented. The Farmer Managed Agroforestry Farming System (FMAFS), developed in Niger provides a set of guiding principles for effective utilization of edible multi-purpose acacias such as *A. saligna* in Agroforestry farming systems. Progress and plans for edible acacia development in northern Ghana and recent plans for scale up in Niger show that edible, multi-purpose acacias may have a vital role in helping to restore degraded lands, improve livelihoods, food security, farm resilience and contribute to adaptation to climate change.

Acacia saligna for food security and Environ.

Appendix - List of Project Members

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Acacia saligna for food security and Environmental Rehabilitation