ONLINE JOURNAL OF ANIMAL AND FEED RESEARCH


An International Peer-Reviewed Journal which Publishes in Electronic Format

Volume 5, Issue 1, January 2015

ISSN 2228-7701

# Online Journal of Animal and Feed Research

An international peer-reviewed journal which publishes in electronic format (online)

*Online J. Anim. Feed Res.*, 5 (1): Jan 25, 2015

Behzad Shokati
PhD student, Department of Agronomy and Plant Breeding, Faculty of Agriculture, University of Maragheh, IRAN (Email: behzad_sh1987@yahoo.com)
Agriculture: Environment, Nutritive value and utilization of feeds
Ekrem LAÇİN
PhD, Professor, Dept. Animal Science and Production, Facult. Vet. Med., Atatürk University, TURKEY (Email: ekremlacin@hotmail.com)
Nutrition - Non-Ruminants
Fazul Nabi Shar
PhD, Lecturer, Faculty of Veterinary & Animal Sciences, Lasbela University of Agriculture Water & Marine Sciences, Uthal Balochistan, Pakistan (Email: fazulnabishar@yahoo.com)
Clinical Veterinary Medicine, Poultry & Animal Husbandry
Fikret Çelebi
PhD, Prof., Dep. Physiology, Facult. Vet. Med., Atatürk University, Erzurum, TURKEY (Website; Email: fncelebi@atauni.edu.tr )
Physiology and Functional Biology of Systems
Firew Tegegn
Bahir Dar University, ETHIOPIA (Email: firewtegegne@yahoo.co.uk)
Animal Nutritionist
Ferdaus Mohd. Altaf Hossain
DVM, Sylhet Agricultural University, Bangladesh; not shah Jalal University of Science & Technology, BANGLADESH (Email: ferdaus.dps@sau.ac.bd)
Microbiology, Immunology, Poultry Science, and Public Health
Hamid Mohammadzadeh
PhD, Assistant Prof., Department of Animal Science, Faculty of Agriculture, University of Tabriz, IRAN (Email: hamidmhz@ag.iut.ac.ir)
Nutrition - Ruminants
Hazim Jabbar Al-Daraji
PhD, Professor, University of Baghdad, College of Agriculture, Abu-Ghraib, Baghdad, IRAQ (Email: prof.hazimaldaraji@yahoo.com)
Avian Reproduction and Physiology
John Cassius Moreki
PhD, Department of Animal Science and Production, Botswana College of Agriculture, Gaborone, BOTSWANA (Email: jcmoreki@gmail.com)
Nutrition - Non-Ruminants, Breeders, Livestock management
Manish Kumar
Prof. Dr., Society of Education (SOE), INDIA (Email: manishzoology06@gmail.com)
Pharmacology, Ethnomedicine
Megiste Taye
PhD, Seoul National University, SOUTH KOREA (Email: mengistietaye@yahoo.com)
Comparative genomics and bioinformatics
Mohammed Yousuf Kurtu
Associate Prof., Animal Sciences Department, Haramaya University, Dire-Dawa, ETHIOPIA (Email: mkurtu2002@yahoo.com)
Animal Science, Nutrition
Muhammad Saeed
PhD candidate, Northwest A&F University, Yangling, 712100, CHINA (Email: muhammad.saeed@nwsuaf.edu.cn)
Nutrition - Ruminants
Naser Maheri Sis
PhD, Assistant Prof., Dept. Anim. Sci., I.A.U.-Shabestar, IRAN (Website; Emails: maherisis@iaushab.ac.ir; nama1349@gmail.com)
Nutrition - Ruminants, Nutritive Value, Utilization of Feeds
Nilüfer SABUNCUOĞLU ÇOBAN
PhD, Professor, Department of Animal Science and Production, Faculty of Veterinary Medicine, Atatürk University, TURKEY (Website; Email: ncoban@atauni.edu.tr)
Animal Hygiene, Physiology, Animal Welfare
Ömer ÇOBAN
PhD, Professor, Department of Animal Science and Production, Atatürk University, TURKEY (Website; ocoban@atauni.edu.tr)
Nutrition - Ruminants
Paola Roncada
PhD, Associate Professor, Veterinary Pharmacology and Toxicology, University of Bologna, ITALY (Email: paola.roncada@unibo.it)
Pharmacokinetics
Raga Mohamed Elzaki Ali
PhD, Assistant Prof., Department of Rural Economics and Development,University of Gezira, SUDAN (Email: ragaelzaki@yahoo.co.uk)
Animal-feed interactions, Nutritive value
Saeid Chekani Azar
PhD, Dept. Anim. Sci., Facult. Vet. Med., Atatürk University, TURKEY (Emails: saeid.azar@atauni.edu.tr; schekani@gmail.com)
Physiology, Product Quality, Human Health and Well-Being,
Shahin Eghbal-Saeid
PhD, Assiociate Prof., Dep. Anim. Sci., I.A.U., Khorasgan (Isfahan), IRAN (Email: shahin.eghbal@khuisf.ac.ir)
Animal Genetics and Breeding
Shahin Hassanpour
Dept. Physiology, Facult. Vet. Med., I.A.U., Shabestar, IRAN (Email: shahin.hassanpour@yahoo.com)
Physiology and Functional Biology of Systems

---

## Join OJAFR Team

As an international journal we are always striving to add diversity to our editorial board and operations staff. Applicants who have previous experience relevant to the position may be considered for more senior positions (Section Editor, SE) within OJAFR. All other members must begin as Deputy Section Editors (DSE) before progressing on to more senior roles. Editor and editorial board members do not receive any remuneration. These positions are voluntary.

If you are currently an undergraduate, M.Sc. or Ph.D. student at university and interested in working for OJAFR, please fill out the application form below. Once your filled application form is submitted, the board will review your credentials and notify you within a week of an opportunity to membership in editorial board.

If you are Ph.D., assistant, associate editors, distinguished professor, scholars or publisher of a reputed university, please rank the mentioned positions in order of your preference. Please send us a copy of your resume (CV) or your Live DNA or briefly discuss any leadership positions and other experiences you have had that are relevant to applied Animal and Feed Researches or publications. This includes courses you have taken, editing, publishing, web design, layout design, and event planning.

If you would like to represent the OJAFR at your university, join our volunteer staff today! OJAFR representatives assist students at their university to submit their work to the OJAFR. You can also, registered as a member of OJAFR for subsequent contacts by email and or invitation for a honorary reviewing articles.

Download OJAFR Application Form

Archive

# Volume 5 (1); January 25, 2015

**Research Paper**

## Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages.

Maha M.M.A, Abogroun H.A., Ibraheem M.T.

*Online J. Anim. Feed Res.,* 5(1): 01-08, 2015; pii: S222877011500001-5

**Abstract**

The effects of nitrite and citric acid as preservatives on the chemical composition and pH of the canned beef sausage were investigated after three months storage at room temperature (35±5ºc). Two experiments were conducted in this study, the first, was undertaken to determine the effect of nitrite as a preservative on the chemical composition and pH of the canned beef sausages retorted at 107.2°C (225ºF) for 80 minutes, and at 115.5°C (240ºF) for 40 minutes. The second experiment, which was based on the results of the first one, was conducted to determine the effects of the absence of nitrite on the canned beef sausage processed with meat treated by immersion in 1% citric acid before processing at (80 and 30ºc) for one minute and drained, then the product retorted at 107.2°C for 80 minutes. The evaluation of percentages of the dry matter, ash, crude protein, fat and also pH were done monthly. The results in experiment 1 indicated that, percentages of the dry matter, ash and crude protein before and after canning of sausages were not significantly different (P>0.05). The fat (%) was significantly different among treatments (P<0.05) in the canned samples, and not in the raw samples. However, there was slight decrease in moisture content (increase in dry matter), ash, protein and fat percentages with increasing of storage period. The results in experiment 2 demonstrated that the dry matter, ash, crude protein and fat percentages were not significantly different (P>0.05) for the raw, cooked and canned sausages. Generally it was observed a decrease in moisture content (increases in dry matter content), ash%, crude protein fat (%) and pH value with increasing of storage period. Citric acid had no clear effect on chemical properties and pH value.

**Keywords:** Nitrite, Canned sausage, Citric acid.

Full text-PDF XML DOAJ

**Research Paper**

## Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan.

Saeed S.Y and Fadel Elseed A.M.A.

*Online J. Anim. Feed Res.,* 5(1): 09-17, 2015; pii: S222877011500002-5

**Abstract**

This case study was conducted to assess the management practices in the dairy farms of Eastern Nile and Khartoum North localities, Khartoum State, Sudan. A questionnaire targeting local dairy producers was used to cover 70 milk producers in the areas of Tibna, Silate, Eidbabiker and Elafoon. The single-visit, multiple-subject approach was used for data collection. The results showed that 53% of the farm owners adopted traditional type of animal keeping. The housing of calves was in groups. Calves, in general looked thin. The number of calves kept together was large and all calves, pre weaning, were kept in the same pen. Eighty-five percent of the farm's cows had high body condition score (BCS) than recommended (obese cows). Ninety-four percent of the owners were not interested in measuring the weight of their animals or calves at birth. The percentage of the infectious diseases such as Mastitis, Foot and Mouth disease, Contagious Bovine Box and Pleuro–phneumonia were found to be 99%, 51%, 13% and 11%, respectively. Diarrhea and Jaundice were the major causes of mortality in suckling calves in the study area. The respondents mentioned three major problems afflicting the dairy sector which were the high cost of nutrition, prices of drugs and lack of new technologies. Lack of extension services, poor veterinary services and scarcity of water comprised as major setbacks.

**Keywords:** Dairy Management, Housing, Calves Management, Body Condition Score, Infectious Diseases.

Full text-PDF XML DOAJ

**Research Paper**

## Nutritive value of rubber seed (*Hevea Brasiliensis*).

Hossain M.E., Karim M.H., Alam S. and Nath S.K.

*Online J. Anim. Feed Res.,* 5(1): 18-21, 2015; pii: S222877011500003-5

**Abstract**

The study was undertaken to find out the chemical composition of rubber seeds (Hevea brasiliensis) available in Bangladesh. Hevea brasiliensis seeds were collected directly from 200 rubber trees of the rubber garden in the Bandarban area under standard random sampling technique. Seeds were decorticated, ground and dried in hot air oven. Chemical analyses of the samples were carried out in triplicate for moisture, dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), ether extract (EE) and ash in the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Metabolizable energy (ME) was calculated mathematically by using standard mathematical formula. Results indicated that, decorticated Hevea brasiliensis seeds contained 85.7% DM, 26.1% CP, 43.0% CF, 13.8% NFE, 11.0% EE and 1.8% ash. ME contents in in the seeds was 2101.1 kcal/kg DM. Since, decorticated rubber seeds contained substantial amount of metabolizable energy and proximate components, therefore it could be assumed that, like other unconventional feeds, it might be a promising feed resource for livestock.

**Keywords:** Chemical Composition, Hevea brasiliensis, Metabolizable Energy, Nutritive Value

Full text-PDF XML DOAJ

**Research Paper**

## Utilization of *Limnocharis flava*, an invasive aquatic weed from Kuttanad wetland ecosystem, Kerala, India as a potential feedstock for livestock.

Smitha Chandran S and Ramasamy EV.

*Online J. Anim. Feed Res.,* 5(1): 22-27, 2015; pii: S222877011500004-5

**Abstract**

The chemical composition, nutritive value and trace element profiles of *Limnocharis flava*, an emergent aquatic weed during its different growth stages was determined to evaluate as possible cattle feed. Samples were analyzed at three progressive morphological stages of the plant, pre-flowering, flowering and post-flowering. The moisture content, dry matter (DM), ash content, crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen free extract (NFE) and mineral constituents like sodium (Na+) potassium (K+), calcium (Ca2+), phosphorous (P) and trace elements like iron (Fe2+), copper (Cu2+), manganese (Mn2+), zinc (Zn2+), lead (Pb2+), chromium (Cr2+ ) nickel (Ni+) and cadmium (Cd+) contents were analyzed. The moisture content, organic matter (OM), acid detergent fiber content increased during maturation, while CP and EE were found decreased with increased growth stage. Only slight fluctuations occurred in Calcium, Potassium, Phosphorous and Sodium contents. The highest values for crude protein, fiber content, NFE and EE were observed at the flowering stage. These plant posses several characteristics which makes it a nutritious feed suitable for domestic livestock, and is recommended to use L.*flava*, particularly at the flowering stage of growth.

**Keywords:** *Limnocharis flava*, Aquatic Weed, Nutritive Value, Chemical Composition

Full text-PDF XML DOAJ

**Research Paper**

## Nutritive value of Sal seed (*Shorea Robusta*).

Hossain M.E., Kabir M.H., Sarma S.M. and Sikder H.

*Online J. Anim. Feed Res.,* 5(1): 28-32, 2015; pii: S222877011500005

**Abstract**

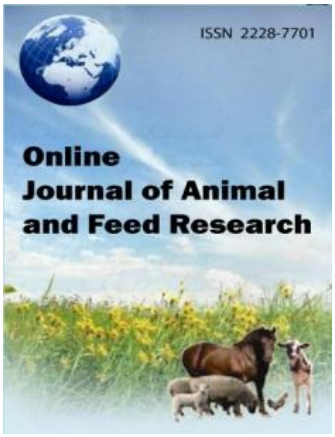
The study was undertaken to find out the chemical composition and nutritive value of Sal seed (*Shorea robusta*) available in Bangladesh. Shorea robusta seeds were collected from different remote places of study areas. Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash (TA) in the animal nutrition and poultry research and training centre (PRTC) laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Results indicated that, air dried corticated Shorea robusta seed contained 91.6% DM, 7.7% CP, 17.8% CF, 8.1% EE, 54.3% NFE

and 3.7% TA. Similarly, air dried decorticated seed contained 88.7% DM, 8.8% CP, 7.3% CF, 10.0% EE, 58.6% NFE and 4.0% TA. Air dried seed shell contained 88.5% DM, 5.8% CP, 39.3% CF, 3.7% EE, 34.8% NFE and 4.9% TA. Metabolizable energy (ME) was 2614.2 Kcal/kg, 2933.0 Kcal/kg and 1582.9 Kcal/kg in corticated seed, decorticated seed and seed shell respectively. It could therefore be inferred that, the Shorea robusta seed seems nutritionally sound enough to be utilized as unconventional feed for ruminant especially during scarcity period.
**Keywords:** Chemical Composition, Nutritive Value, Metabolizable Energy, Shorea robusta.

Full text-PDF XML DOAJ

Archive

# Online Journal of Animal and Feed Research




ISSN: 2228-7701

Frequency: Bimonthly

Current Issue: 2015, Vol: 5, Issue: 1 (January)

Publisher: SCIENCELINE

*Online Journal of Animal and Feed Research* is an internationalpeer-reviewed journal, publishes the full text of original scientific researches, reviews, and case reports in all fields of animal and feed sciences, bimonthly and freely on the ınternet ...view full aims and scope

www.jwpr.science-line.com

» JWPR indexed/covered by NLM/PubMed, CABI, CAS, AGRICOLA, DOAJ, Ulrich's™, GALE, ICV 2015 = 71.65), Worldcat, EZB, TOCs ...details

» Open access full-text articles is available beginning with Volume 1, Issue 1.

» Full texts and XML articles are available in ISC-RICeST and DOAJ.

» This journal is in compliance with Budapest Open Access Initiative and International Committee of Medical Journal Editors' Recommendations.

» We are member of WAME

» High visibility of articles over the internet.



**Editorial Offices:**
Atatürk University, Erzurum 25100, Turkey
University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada
University of Maragheh, East Azerbaijan, Maragheh 55136, Iran
Homepage: www.science-line.com
Phone: +98 914 420 7713 (Iran); +90 538 770 8824 (Turkey); +1 204 8982464 (Canada)
Emails:
administrator@science-line.com
saeid.azar@atauni.edu.tr

*Online Journal of Animal and Feed Research*

*Volume 5, Issue 1: 01-08; Jan 25, 2015* ISSN 2228-7701

# EFFECT OF NITRITE AND CITRIC ACID ON THE CHEMICAL COMPOSITION AND pH OF THE CANNED BEEF SAUSAGES

M.M.A. MAHA[1], H.A. ABOGROUN[2], M.T. IBRAHEEM[1]

[1]*Sudan University of Science and Technology, College of Animal Production Science and Technology, Sudan*
[2]*Alzaeim ALazhari University, Al-ShaBiyya, Khartoum North, Sudan*
*Email: dr.mahamma@gmail.com

**ABSTRACT***:* The effects of nitrite and citric acid as preservatives on the chemical composition and pH of the canned beef sausage were investigated after three months storage at room temperature (35±5°c). Two experiments were conducted in this study, the first, was undertaken to determine the effect of nitrite as a preservative on the chemical composition and pH of the canned beef sausages retorted at 107.2°C (225°F) for 80 minutes, and at 115.5°C (240°F) for 40 minutes. The second experiment, which was based on the results of the first one, was conducted to determine the effects of the absence of nitrite on the canned beef sausage processed with meat treated by immersion in 1% citric acid before processing at (80 and 30°c) for one minute and drained, then the product retorted at 107.2°C for 80 minutes. The evaluation of percentages of the dry matter, ash, crude protein, fat and also pH were done monthly. The results in experiment 1 indicated that, percentages of the dry matter, ash and crude protein before and after canning of sausages were not significantly different (P>0.05). The fat (%) was significantly different among treatments (P<0.05) in the canned samples, and not in the raw samples. However, there was slight decrease in moisture content (increase in dry matter), ash, protein and fat percentages with increasing of storage period. The results in experiment 2 demonstrated that the dry matter, ash, crude protein and fat percentages were not significantly different (P>0.05) for the raw, cooked and canned sausages. Generally it was observed a decrease in moisture content (increases in dry matter content), ash%, crude protein fat (%) and pH value with increasing of storage period. Citric acid had no clear effect on chemical properties and pH value.

**Keywords:** Nitrite, Canned sausage, Citric acid.

ORIGINAL ARTICLE
pii: S2228770115000l-5
Received 12 Dec. 2014
Accepted 15 Jan. 2015

## INTRODUCTION

New processing concepts such as the application of variable retort temperature have received attention from processing experts and promises to improve both the economy and quality of thermally processed foods (Awuah et al., 2007). In the past Sudanese preferred fresh meat to processed meat, but now the profitability and technological advances, and the change in the life style (the working women have a little time for food preparation), will probably affect the rate and ultimate extent to which meat is processed.

Thermal processing, specifically retort processing, has been used as a common preservation technique in food industry for shelf stable low acid foods. The United States Code of Federal Regulations defines commercial sterility as "The condition achieved by application of heat, chemical sterility, or other appropriate treatment that renders the equipment and containers free of viable microorganisms having public health significance, as well as microorganisms of nonhealth significance, capable of reproducing in the food under normal non refrigerated conditions of storage and distribution (USFDA, 2009). In recent times, with the development of computing technology, programs are available to thermal process requirements, and also online monitoring and controlling of the thermal process (Fellows, 2009).

Meat products that can be stored at room temperature without the risk of microbial spoilage are considered to be shelf stable products. They include canned meats such as ham, tuna and chicken, jerky, dry sausages snack sticks, summer sausage and freeze dried meat. Because these products do not need cold temperatures for preservation, they are popular for camping, trips, hunting and fishing expeditions and other activities where refrigeration may not be available. In addition, they are convenient product to have on hand in your cupboard (Elizabeth, 1994). So in the Sudan the farmers in agricultural areas, the army in the military regions, people in the disaster areas, and regions of the displaced people, are in need of shelf stable and acceptable product that does not require refrigeration. Meat canning is a suitable method of preservation to solve these problems that meet the availability of safe foods in those areas.

Today consumers all over the world especially in industrialized and developed countries increasingly demand minimally processed foods and food stuffs, which retain natural flavor, color, texture, nutritional characteristics, and contain fewer additives (e.g. preservatives) especially chemical additives (Ohlsson and Bengtsson, 2002). Accordingly to encourage the consumption of processed meat we must get rid of the use of chemical additives, as



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res.*, 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

nitrite has been reported to be carcinogenic above and beyond its possible role in formation of nitrosamines (Person and Tauber, 1989). Qing-Lidong et al. (2007) indicated that no significant difference existed among the pH values and fat content of the cooked sausage with different sodium nitrite addition. The objectives of the study were, to investigate the use of many preservatives in canning in order to decrease the time and temperature required for commercial sterilization, to evaluate the necessity of using nitrite in canned sausages by examining its effect on chemical composition and pH of canned beef sausages, and also to develop a meat product that does not need freezing or refrigeration and accessible to people living in remote areas.

## MATERIALS AND METHODS

### Experiment 1

Approximately 7 kgs of lean meat (top side) cut were taken from beef animals of similar breed and age after 24 hours from slaughter at Meat Technology Department in Kuku Animal Production Research Centre and used in sausage preparation. The meat was ground through (0.64 cm diameter) plate of an electrical meat grinder. Synthetic cellulose casings were obtained from local market and round sanitary acid-resistance cans (6.83cm in diameter and 10.16cm in. height of nominal capacity 315 gm) were obtained from a local processing plan .

### Sausage preparation

The ground meat (6 kgs) was divided into two equal batches, one batch was formulated using the ingredients in Table 1 and 155 ppm sodium nitrite while the other was formulated using the same ingredients in Table 1 without addition of nitrite and considered as control. Each batch was chopped separately. The chopper was started after the minced meat was introduced. Salt, nitrite (in one batch), and half of the recommended ice water were added and uniformly dispersed. Then, the binder and seasoning were added together, with the remainder of the recommended ice water. The entire mass for each batch was chopped for about 5 minutes. The batter for each batch was then stuffed into cellulose casings of 22 mm in diameter and linked at length about 8 cm. The product was cooked for 15 minutes in boiling water followed by immediate cooling in ice water for 5 min. The sausages were peeled, packed in polyethylene bags and stored in refrigeration (4°C) over night. The product of each batch was divided into two treatments, in one treatment the canning was done by retorting at 107.2°C for80 minutes, and in the other treatment the canning was done by retorting at 115.5°C for 40 minutes and considered at 0 month storage. The other samples were awaiting chemical test at intervals of 1, 2, 3 months of storage.

Table 1 - Ingredients based on total mixed base

| Ingredients | Percentage |
|---|---|
| Cold water (crushed ice) | 12.20 |
| Salt | 2.40 |
| Ground pepper | 0.30 |
| Sugar | 0.30 |
| Mustard powder | 0.20 |
| Skimmed milk powder | 3.40 |

### Canning operation

The empty cans were spray washed with26.5°C water in accordance with federal meat inspection regulation (Pearson and Tauber, 1989). Each batch of the product was subdivided into two portions, one part to be canned, and retorted at 107.2° C for 80 min, and the other part to be canned and retorted at 115.5°C for 40 minutes. The cans were filled with sausages. Seven pieces (links) of sausage weighing about 160(g) were put in each can. Then the remaining space was filled with decontaminated boiling water. The cans were closed by double sealer machine (Mp 502120207/s) in the Canning Unit of the Food Research Centre, Shambat. Cans were placed into a vertical non-agitating retort. After retorting, cans were water cooled by immersing in a cold water tank. Temperature of water was approximately (15°c). The wet cans were dried by heat which was permitted to accelerate evaporation (Pearson and Tauber, 1989).

### Product storage

The cans were labeled and stored at room temperature Table 2, 30gm of samples were taken randomly after 72 hours (incubation period)from canning for chemical analysis.

### Experiment 2

**Meat preparation:** Meat samples were taken from beef animals of similar breed and age after 24 hours from slaughter at the Meat Technology Department in Kuku Animal Production Research Center.



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res.*, 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Approximately 7 kg of lean meat (top-side) cut were trimmed to a minimum amount of fat were used in sausage preparation in each replicate (three replicates were performed for each treatment). The lean meat was divided into two batches, one batch treated with citric acid and another batch treated with decontaminated water (free of contamination by water filtration). Each batch was divided into two parts. The first part was dipped in 1% (at 30ºC) citric acid for one minute and drained for one minute. The 2nd part was dipped in 1% citric acid at (80ºc) for one minute and drained for one minute. The third part was dipped in decontaminated water at 30ºC for one minute and drained for one minute. The fourth part was dipped in decontaminated water at 80ºC for one minute and drained for one minute. The meat was ground through 0.25 in/plate of electrical meat grinder. The same casings and cans as in experiment 1 were used. Four treatments were obtained: sausages processed with meat dipped in 1% citric acid at 30ºC for one minute and retorted at 107.2 ºC for 80 minutes, sausages processed with meat dipped in 1% citric acid at 80ºc and retorted at 107.2ºC for 80 minutes, sausages processed with meat dipped in decontaminated water at 30ºc for one minute and retorted at 107.2ºC for 80 minutes ,Sausages processed with meat dipped in decontaminated water at 80ºc for one minutes and retorted at 107.2Cº for 80 minutes.

### Sausages preparation

Sausages were prepared following the previously mentioned procedures in experiment one. Random samples of raw (uncooked) and cooked sausages were taken for chemical analysis and pH measurement.

### Sausages canning

All procedures of canning were performed as in experiment one except the retorting was done for all treatments at 107.2ºC for 80 minutes.

### Product storage

The cans were labeled and stored for three months at room temperature Table 2 waiting chemical analysis and pH measurement every month. Each variable determination was replicated three times.

Table 2 - Average temperature and humidity of storage for the canned sausages

| No. of experiment | Period of storage | Temperature C° | Humidity % |
|---|---|---|---|
| 1 | First month | 35.30 | 32.25 |
| | Second month | 31.90 | 23.25 |
| | Third month | 30.50 | 21.30 |
| 2 | First month | 30.10 | 16.20 |
| | Second month | 30.90 | 14.80 |
| | Third month | 35.70 | 21.10 |

### Proximate analysis

Three sausage links were taken randomly from each treatment of the pre-cooked and canned sausages and then a proximately 50 gms portion were taken from different places of each link, and mixed well to assure a representative sample for proximate analysis and pH measurement. Moisture, crude protein, fat and ash content were determined accordingly to the A.O.A.C. (2002) methods.

### Statistical Analysis

Statistical analysis was performed on all data of the various experiments using SPSS and was subjected to analysis of variance (ANOVA). Least significant difference (LSD) was used for mean separation (Gomez & Gomez, 1984).

## RESULTS AND DISCUSSION

### Experiment 1

Proximate composition: The results in (Table 3) showed that, addition of nitrite was not affected significantly ($P>0.05$) on the dry matter, ash, crude protein as well as fat content of the raw product (pre-canning) although there was a slight decrease in protein content of the sausages processed without nitrite. Qing- Lidong et al. (2007) in their study for determining the effect of sodium nitrite on the textural properties of cooked pork sausages during days at 0-21ºC storage which were prepared at four levels of sodium nitrite (0, 50, 100 and 150mg/kg), found significant differences in moisture and protein content between the control and nitrite added sausages ($P<0.05$), but not for fat contents among the different batches. As for fat content the results are agree with the previous study. The disagreement between the results of the previous study and these results concerning the dry matter, ash and crude protein, may be due to the difference in amount of nitrite used, that we use( 155 p.p.m) in the processing ,also the difference in type of meat used ,that pork was other than beef. Qing-lidong et al., 2007 in their study of nitrite



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res.*, 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

added sausages during cold storage, found that there was no significant difference in fat contents between the different batches and the control.

The dry matter% as shown in Table 4 was increased with the increasing of storage period but the increase was not significant (P>0.05); also the increase in processing temperature caused slight increase in dry matter content. These findings are in agreement with Pearson and Tauber (1989) who reported that, cooking decrease the water content of raw meat, especially on the surface which intern lower the water activity and improves the peal ability of frankfurters and extended their shelf life. The results are also agreed with that reported by Garcia-Arias et al. (2004) and Garcia et al. (1994). As reported by Rasmussen and Morrissey (2007), who found that, percent moisture decreased significantly following the canning process. Leblanc and Leblanc (2007) mentioned that, assessed samples of vacuum canned frozen control lobster meat and meat retorted for 28, 35, 40 and 45min, respectively. Results showed a decrease in moisture content with sterilization.

**Table 3 - Means and standard errors (S.E.) for Dry matter%, Ash %, Crude Protein %, Fat% and pH of the raw sausage treatments***

| Independent Variables | Treatment* | | S.E. |
|---|---|---|---|
| | Nitrite | | |
| | With | Without | |
| Dry mater % | 30.24 [a] | 30.15 [a] | ± 0.30 |
| Ash % | 2.17 [b] | 2.28 [b] | ± 0.04 |
| Protein | 20.28 [c] | 19.58 [c] | ± 0.23 |
| Fat % | 2.82 [d] | 2.50 [d] | ± 0.11 |
| pH | 6.97 [e] | 6.92 [e] | ± 0.03 |

[a,b,c,d,e]: Means in the same row bearing similar superscripts are not significantly different (P>0.05); * Sausages canned using 107.2°C and 115.5°C processing temperatures with and without nitrite.

**Table 4 - Means and standard error (S.E.) for Dry matter % of the various canned sausage treatments*.**

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | 107.2 °C Nitrite | | 115.5°C Nitrite | | |
| | Without | With | Without | With | |
| 0 | 27.55[a] | 29.08 [a] | 28.55 [a] | 28.15 [a] | ± 0.16 |
| 1 | 30.06 [a] | 29.51 [a] | 29.49 [a] | 30.00 [a] | |
| 2 | 30.43 [a] | 30.79 [a] | 30.29 [a] | 31.24 [a] | |
| 3 | 32.20 [a] | 31.94 [a] | 32.04 [a] | 32.22 [a] | |

[a]Means bearing similar superscripts are not significantly different (P>0.05); *Sausages canned using 107.2°C and 115.5°C processing temperatures with and without nitrite.

The results in Table 5 explained that, there was a decrease in ash% with increasing of storage period irreversible to the action of nitrite which caused and increase in ash%. The results are in agreement with the findings of Slabyj and Carpenter (2006) who were analyzed blue muscles (mytilus edules), the raw and processed meats (fresh, frozen and canned) for proximate composition and mineral content. Initial steaming of blue muscles resulted increase in dry weight of meats but a decrease in carbohydrates and ash content.

**Table 5 - Means and standard error (S.E.) for Ash % of the various canned sausage treatments*.**

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | 107.2 °C Nitrite | | 115.5°C Nitrite | | |
| | Without | With | Without | With | |
| 0 | 2.30[a] | 2.10[a] | 2.22[a] | 2.13[a] | ± 0.10 |
| 1 | 1.70[a] | 1.90[a] | 1.45[a] | 1.85[a] | |
| 2 | 1.40[a] | 1.60[a] | 1.42[a] | 1.80[a] | |
| 3 | 1.40[a] | 1.60[a] | 1.48[a] | 1.70[a] | |

[a]Means bearing similar superscripts are not significantly different (P>0.05); * Sausages canned using 107.2°C and 115.5°C processing temperatures with and without nitrite.

As shown in the results of protein% (Table 6) the addition of nitrite in canned sausage kept the protein% higher than the control (without nitrite). Generally the protein% was slightly decreased with increasing of storage period, but the difference was not significant among treatments (P>0.05). The increase in canning temperature (107.2-115.5ºC) was not affected the protein content for the different treatments. These results are in agreement with Qing-Lidong et al. (2007) who found significant differences in moisture and protein contents between the control and nitrite added sausage. The increase temperature of canning was slightly affected on the protein content. Aberle et al. (2001) stated that, when proteins of muscle are exposed to heat, they lose their native



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res.*, 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

structure and undergo several changes in configuration which may be accompanied or followed by aggregation, or clumping, of protein molecules (coagulation), the presence of which indicates a loss in protein solubility. The net protein utilization of meat autoclaved in the laboratory in the presence of wheat flour and glucose was 70 compared with a value of 78 for the same meat autoclaved alone. Low net protein utilization value of the canned meat product is due both to the high content of connective tissue and the loss of available methionine on canning in the presence of the other food stuffs (Bender and Husaini, 1976).

**Table 6 - Means and standard error (S.E.) for crude protein % of the various canned sausage treatments*.**

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | 107.2 °C Nitrite | | 115.5°C Nitrite | | |
| | Without | With | Without | With | |
| 0 | 18.75[a] | 20.20[a] | 18.80[a] | 20.55[a] | ± 0.03 |
| 1 | 18.47[a] | 19.62 [a] | 18.20[a] | 19.55[a] | |
| 2 | 17.77[a] | 18.87[a] | 17.70[a] | 18.75[a] | |
| 3 | 17.48[a] | 17.0[a] | 17.50[a] | 17.90[a] | |

[a] Means bearing similar superscripts are not significantly different (P>0.05); *Sausages canned using 107.2°C and115.5°C processing temperatures with and without nitrite.

As for fat% there was a significant decrease in fat content with increasing of storage period (Table 7; P>0.05). The increase in processing temperature (115.5-117.2)ºC did not significantly affected on fat content. Addition of nitrite had no significant effect on fat% except for the two samples that processed with and without nitrite and canned at 115.5ºC. These results are disagree with the Quing-Lidong et al. (2007) who found no significant difference in fat between the control and nitrite added sausage (P<0.05). Rasmussen & Morrissey (2007) reported that, percent lipid decreased significantly after canning. This finding was in agreement with our results in the present study. Garcia-Arias et al., 2004 and Garcia Arias et al., 1994, found that the canning process has been reported to alter the proximate composition of albacore tuna resulting in a large increase in percent tepid which was not in agreement with our findings and this may be due the difference in the type of meat. During chopping the fat is coated with protein. Myosin in particular plays a very important role in completely covering the fat particles. Once the fat coated with myosin, of stable only for a period of hours, or all most about a day. Heating the emulsion, however, coagulates the protein and stabilizes the emulsion, so that the protein holds the fat in suspension for unlimited period of time (Pearson and Tauber, 1989).

**Table 7 - Means and standard error (S.E.) for fat % of the various canned sausage treatments*.**

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | 107.2°C Nitrite | | 115.5°C Nitrite | | |
| | Without | With | Without | With | |
| 0 | 2.57[b] | 2.92[a] | 2.77[a] | 2.77[a] | ± 0.08 |
| 1 | 2.02[c] | 2.28[d] | 1.95[ce] | 2.33[d] | |
| 2 | 1.61[fgm] | 1.69[ghi] | 1.65[fhk] | 1.83[ei] | |
| 3 | 1.42[j] | 1.5[gkj] | 1.42[jl] | 1.45[jm] | |

[a,b,c,d,e] Means bearing different superscripts are significantly different (P<0.05); * Sausages canned using 107.2°C and115.5°C processing temperatures with and without nitrite.

**Experiment 2**

Proximate composition: Raw and cooked sausages were analyzed for dry matter, ash, crude protein and fat percentage. The results as shown in Table 9 indicated that, there was no significant difference among treatments for all variables. However, raw sausages scored low values for dry matter (high moisture), crude protein, fat and ash content compared to the cooked sausages. Citric acid was not significantly affected on dry matter, crude protein, fat and ash content for the various sausage treatments compared to the control and this may be due to its low concentration (1%). These results are in agreement with Abrele et al. (2001) who were reported from the U.S. Department of agriculture Hand book the proximate composition and caloric content of separable lean of raw and cooked retail cuts of beef which indicate that (protein, fat and ash) percentage were increased in the cooked retail cuts while the moisture% decreased in comparison with the raw cuts. Also Pearson and Tauber (1989) explained that, cooking decrease the water content of raw meat and leads to denaturation and coagulation which involves change in the protein molecule. This may be due to unfolding of the protein or the loss of its characteristic conformation, which decreases its solubility. Chiou et al. (2004) reported that, in small abalone meats were heated at 80ºC and 98ºC for 0-120 min, the decrease in moisture and weight were relatively higher for cooking at 98ºC than at 80ºC.

Means and standard error for dry matter% showed no significant difference among treatments (Table 10; P>0.05) although there was slight increasing in dry matter% age (decrease in moisture %) with increasing of storage period.



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res.*, 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

**Table 9 -** Means and standard errors (S.E.) for Dry matter %, Ash %, Crude Protein %, Fat % and pH of the various sausage treatments*

| Independent Variables | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | Citric acid (1%) | | Treated water | | |
| | 30°c | 80°c | 30°c | 80 °c | |
| **Dry matter (%)** | | | | | |
| Raw sausages | 25.69 [a] | 26.53 [a] | 25.61 [a] | 29.0 [a] | ± 0.35 |
| Cooked sausages | 26.69 [a] | 26.63 [a] | 30.22 [a] | 31.64 [a] | |
| **Crude protein (%)** | | | | | |
| Raw sausages | 18.85 [b] | 19.1 [b] | 18.63 [b] | 18.83 [b] | ± 0.09 |
| Cooked sausages | 19.47 [b] | 19.2 [b] | 20.28 [b] | 19.95 [b] | |
| **Fat (%)** | | | | | |
| Raw sausages | 2.83 [c] | 3.12 [c] | 3.03 [c] | 3.18 [c] | ± 0.07 |
| Cooked sausages | 3.22 [c] | 3.25 [c] | 3.13 [c] | 3.23 [c] | |
| **Ash (%)** | | | | | |
| Raw sausages | 2.07 [d] | 2.37 [d] | 2.07 [d] | 2.37 [d] | ± 0.07 |
| Cooked sausages | 2.12 [d] | 2.12 [d] | 2.28 [d] | 2.17 [d] | |
| **pH** | | | | | |
| Raw sausages | 7.05 [e] | 6.98 [e] | 6.82 [e] | 6.78 [e] | ± 0.08 |
| Cooked sausages | 6.88 [e] | 7.05 [e] | 6.8 [e] | 6.95 [e] | |

[a, b, c, d, e] Means for each independent variable bearing similar superscripts are not significantly different (p>0.05); * Raw meat was dipped in 1% citric acid at 30 °c and at 80° c (dipping and draining were performed for 1 minute in each treatment before processing); Raw meat was dipped in treated water at 30 °C and at 80 °C (dipping and draining were performed for 1 minute in each treatment before processing).

**Table 10 -** Means and standard error (S.E.) for dry matter % of the various sausage treatments*.

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | Citric acid (1%) | | Treated water | | |
| | 30° C | 80°C | 30°C | 80°C | |
| 0 | 31.08 [a] | 30.32 [a] | 31.73 [a] | 30.43 [a] | ± 0.51 |
| 1 | 32.57 [a] | 31.76 [a] | 33.69 [a] | 34.94 [a] | |
| 2 | 34.6 [a] | 33.43 [a] | 34.44 [a] | 33.04 [a] | |
| 3 | 35.23 [a] | 34.42 [a] | 35.47 [a] | 34.92 [a] | |

[a] Means bearing similar superscripts are not significantly different (P > 0.05); * Raw meat was dipped in 1% citric acid at 30 °C and at 80°C (dipping and draining were performed for 1 minute in each treatment before processing); Raw meat was dipped in treated water at 30 °C and at 80°C (dipping and draining were performed for 1 minute in each treatment before processing).

As for crude protein the results in (Table 11) shows slight decrease in the protein content by increasing time of storage, but the difference was not significant. Citric acid and the difference of its temperature had no significant effect on the protein content. Bender and Husaini (1976) pointed that low net protein utilization value of the canned meat product is due both to the high content of connective tissue and the loss of available methionine on canning in the presence of the other food stuffs. Desrosier and Desrosier (1977) demonstrated that, denaturation of protein may be brought about by heat in the presence of moisture. When so denatured, the configuration of the nature protein molecules is lost and specific immunological properties which distinguish most proteins are diminished.

There was no significant difference among treatments for fat% (Table 12; P>0.05). Nevertheless fat content was slightly decreased with increasing of storage period. Citric acid caused no change in the fat content as the increase in its temperature.

As for ash there was no significant difference among treatments (Table 13; P>0.05), but we observed that, the ash content was decreased by increasing of storage period. Citric acid as the difference in its temperature had no significant effect on ash content. Slabyj and Carpenter (2006) claimed that blue mussels (mytilus edulis) have been frozen or canned the raw and processed meats (fresh, frozen and canned) were analyzed for proximate composition and mineral content. Initial steaming of blue mussels resulted in significant increase in dry weight of meats but a decrease in carbohydrates and ash content.

**Table 11 -** Means and standard error (S.E.) for crude protein % of the various sausage treatments*.

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | Citric acid (1%) | | Treated water | | |
| | 30° C | 80°C | 30°C | 80°C | |
| 0 | 18.75 [a] | 18.30 [a] | 18.12 [a] | 18.78 [a] | ± 0.22 |
| 1 | 17.43 [a] | 17.47 [a] | 17.35 [a] | 17.47 [a] | |
| 2 | 17.10 [a] | 16.90 [a] | 16.75 [a] | 16.78 [a] | |
| 3 | 16.39 [a] | 16.53 [a] | 16.23 [a] | 16.29 [a] | |

[a] Means bearing similar superscripts are not significantly different (P > 0.05); * Raw meant was dipped in 1% citric acid at 30 °C and at 80 °C (dipping and draining were performed for 1 minute in each treatment before processing); Raw meant was dipped in treated water at 30 °C and at 80 °C (dipping and draining were performed for 1 minute in each treatment before processing).



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res.*, 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Table 12 - Means and standard error for fat % of the various sausage treatments*.

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | Citric acid (1%) | | Treated water | | |
| | 30 ° c | 80 ° c | 30 ° c | 80 ° c | |
| 0 | 2.35 [a] | 2.97 [a] | 2.97 [a] | 3.2 [a] | ± 0.11 |
| 1 | 2.35 [a] | 2.32 [a] | 2.50 [a] | 2.43 [a] | |
| 2 | 1.69 [a] | 1.62 [a] | 1.49 [a] | 1.91 [a] | |
| 3 | 1.46 [a] | 1.39 [a] | 1.34 [a] | 1.44 [a] | |

[a] Means bearing similar superscripts are not significantly different (P > 0.05); * Raw meat was dipped in 1% citric acid at 30 °C and at 80 °c (dipping and draining were performed for 1 minute in each treatment before processing); Raw meat was dipped in treated water at 30 °Cand at 80 °C (dipping and draining were performed for 1 minute in each treatment before processing).

Table 13 - Means and standard error (S.E.) for ash % of the various sausage treatments*.

| Storage (month) | Treatment * | | | | S.E. |
|---|---|---|---|---|---|
| | Citric acid (1%) | | Treated water | | |
| | 30 ° c | 80 ° c | 30 ° c | 80 ° c | |
| 0 | 2.38 [a] | 2.58 [a] | 2.38 [a] | 2.45 [a] | ± 0.19 |
| 1 | 1.68 [a] | 1.72 [a] | 1.62 [a] | 2.22 [a] | |
| 2 | 1.48 [a] | 1.31 [a] | 1.35 | 1.65 [a] | |
| 3 | 1.35 [a] | 1.17 [a] | 1.20 [a] | 1.21 [a] | |

[a] Means bearing similar superscripts are not significantly different (P > 0.05); * Raw meat was dipped in 1% citric acid at 30 °C and at 80 °C (dipping and draining were performed for 1 minute in each treatment before processing); Raw meat was dipped in treated water at 30 °C and at 80 °C (dipping and draining were performed for 1 minute in each treatment before processing).

## CONCLUSION

It would be concluded that, the canned beef sausages will be of good chemical properties if processed without added nitrite and retorted at 115.5°C for 80 minute at least for 3 months of storage at room temperature. So, we could get rid of nitrite which caused some problems in the meat industry.

### Acknowledgement

Special appreciation to the Sudan University of Science and Technology for the valuable support and fund making it possible to carry out these experiments.

## REFERENCES

AOAC (2002). Official Methods of Analysis {Revision 1 (17th ed)}, Association of official Analytical Chemists, Inc, Arlington VA. (2002).

Aberle ED, Judge MD, Forrest JC, Hedrick, HB and Markel RA (2001): Principles of Meat Science (4th ed) Kendall Hunt. Lowa U.S.A.

Awuah GB, Ramaswamy HS, Economides A (2007). Thermal processing and quality. Principle and overview. J. Chem Eng Proc, 46(6): 584-602.

Bender AE, Husaini AE (1976). Nutritive valsue of proteins in canned meat product. International J. of food Sci & Technology 11(5), 499-503.

Chiou Tze-Kuei, Tsai Cyun-Yu, LAN Huei-Ling (2004). Chemical, physical and Sensory changes of small abalone meat during cooking. Fisheries Science 70(5), 867-874.

Deserosier Norman W, Deserosier James N (1977). The Technology of Food Preservation 4th ed. The new product company U.S.A. AVI Publishing Company, U.S.A.

Elizabeth Boyle, PhD (1994). Shelf stable meat. Department of Animal Science and Industry. Kansus State University.

Fellows, PJ, (2009). Food Processing Technology Principles and Practice, third. ed. Woodhead. Tibor Deak. Thermal Treatment. Corvinus University. Budapest, Hungary.

Garcia-Arias, M Navarro P and Garcia Linares MC (2004). Effect of different thermal treatment and storage on the proximate composition and protein quality in canned tuna. Archivos Latin a mericanos de Nutricion 54(1) pp. 112-117.

Gomez, KS and Gomez, AA (1984). Statistical Procedures for Agricultural Research. 2nd ed. John Wiley and Sons Inc. New York, U.S.A.



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res.*, 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

LeBlanc Raynald J and LeBlanc Eileen L (2007). Effect of retort process time on the physical and sensory quality of canned lobster (Homurus americanus) meat. J. Food Processing and Preservation 14(5): 345-398. Ohlsson T. and Bengtsson N. (2002). Minimal processing technologies in the Food industry, CRC press (2002) (pp. 175-191). Council Publ. 751.

Pearson, AM and Tauber FW (1989). Processed Meat (3nd ed.), AVI Publishing company INC., USA.

Qing-Lidong, Kang Tu, Liyang Gou, Jia-Liyang, Hai Wang, Yu-Yanchen (2007). The effect of sodium nitrite on the textural properties of USFDA (2009) US. Food and drug administration. Thermally processed low acids packaging in hermetically sealed container. In. Code of federal regulations (CFR) Title21. Food and drugs. Part113. Cooked sausage during cold storage. J. Texture Stud 38(5): 537- 554.

Rasmussen Rosalee S and Michael T. Morrissey (2007). Effect of canning on total mercury, protein, lipid, and moisture content in troll-caught albacore tuna (thunnus alalunga) J. Food Chem, 101(3): 1130-1135.

Slabyj E and Carpenter P (2006). Processing effect on proximate composition and mineral content of blue mussels (mytilus edulis). J. Food Sci. 42(5): 1153-1155. Willey on line library.



To cite this paper: Maha M.M.A, Abogroun H.A., Ibraheem M.T. 2015. Effect of nitrite and citric acid on the chemical composition and pH of the canned beef sausages. *Online J. Anim. Feed Res*., 5(1): 01-08.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

*Online Journal of Animal and Feed Research*

*Volume 5, Issue 1: 09-17; Jan 25, 2015* ISSN 2228-7701

# MANAGEMENT PRACTICES OF DAIRY FARMS; CASE STUDY: KHARTOUM NORTH AND EASTERN NILE LOCALITIES, KHARTOUM, SUDAN

Salma Yassin SAEED[1]* and Abdelnasir Mohammed Ahmed FADEL ELSEED[2]

[1]*Department of Animal Production, Faculty of Agriculture, Alzaiem Alazhari University, Khartoum North 13311, Sudan.*
[2]*Department of Animal Nutrition, Faculty of Animal Production, University of Khartoum, Shambat 13314, Sudan.*
*Email: salmaeltelib@gmail.com

**ABSTRACT***:* This case study was conducted to assess the management practices in the dairy farms of Eastern Nile and Khartoum North localities, Khartoum State, Sudan. A questionnaire targeting local dairy producers was used to cover 70 milk producers in the areas of Tibna, Silate, Eidbabiker and Elafoon. The single-visit, multiple-subject approach was used for data collection. The results showed that 53% of the farm owners adopted traditional type of animal keeping. The housing of calves was in groups. Calves, in general looked thin. The number of calves kept together was large and all calves, pre weaning, were kept in the same pen. Eighty-five percent of the farm's cows had high body condition score (BCS) than recommended (obese cows). Ninety-four percent of the owners were not interested in measuring the weight of their animals or calves at birth. The percentage of the infectious diseases such as Mastitis, Foot and Mouth disease, Contagious Bovine Box and Pleuro–phneumonia were found to be 99%, 51%, 13% and 11%, respectively. Diarrhea and Jaundice were the major causes of mortality in suckling calves in the study area. The respondents mentioned three major problems afflicting the dairy sector which were the high cost of nutrition, prices of drugs and lack of new technologies. Lack of extension services, poor veterinary services and scarcity of water comprised as major setbacks.

**Keywords:** Dairy Management, Housing, Calves Management, Body Condition Score, Infectious Diseases.

ORIGINAL ARTICLE
pii: S2228770115000025
Received 02 Dec. 2014
Accepted 21 Jan. 2015

## INTRODUCTION

Dairy cattle are kept all over the world. Keeping a dairy cow can be very lucrative, especially close to urban areas. The dairy cow is, however, a very valuable animal and owning one entails a number of risks. The biggest risk is losing the animal. Low productivity due to poor management will also lead to losses (Bonnier et al., 2004). Cow better management can increase overall health, milk yield, and productive life because of enhanced animal welfare (Wagner-Storch et al., 2003). Housing systems for dairy cows vary from housing cows throughout the year to housing cows in the winter months only. Outdoors grazing is allowed throughout the year in regions with the appropriate climate. Systems in which cows are housed throughout the year [referred to as zero-grazing, (ZG) systems] are used in areas where grazing the cattle is not the most efficient or cost-effective use of the land. Cows can be fed high levels of concentrate feed more easily when they are housed, so extended or continuous housing systems are more common in farms having cows with a high genetic potential for milk yield. It is hypothesized that the increased length of the housing period may have adverse effects on cow lameness and leg injury (Haskell et al., 2006). Provision of adequate shading is the easiest and most effective way in controlling cows' heat stress. Direct sunlight adds a tremendous heat load to the cow, but heat energy that is reflected from areas exposed to the sun such as concrete floors, barn walls and other exposed surfaces also add to the cow's heat stress. Shading reduces the black globe environmental temperature (a measure of temperature and radiant energy) and lowers the rectal temperature and respiration rate of cows, increasing feed intake and milk yield. Gains in milk production of 10 to 20 percent occurred where shaded and unshaded cows were compared (West, 2009). Loose housing barns provide shade for cows without the cost of free stalls or the concrete floors. These barns have a sand base mounded in the center of the barn to minimize accumulation of moisture. The bedding must be cleaned and maintained regularly to prevent pitting and fresh sand must be added as needed (West, 2009).

Kulneff (2006) studied the dairy management system in relatively modern systems in Khartoum State, Sudan, and reported that the animals were housed in pens on the ground, surrounded by either mud walls or iron fences and with access to roofs for shadow. The weaned female calves are kept as replacement heifers, as for the males, there were disposed by sale, and only one or two were retained for the purpose of breeding. A study carried out in Khartoum State, Sudan, revealed that 50% of the farm owners purchased their drugs directly from drug stores, 30% were neither dealt with clinics nor purchased drugs to treat their sick animals, 10% purchased their



To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res.*, 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

drugs from drug stores and treat their animals by themselves and 10% preferred to deal with veterinary clinics to treat their animals (Mustafa, 2008). The study area is known to be the main source of milk supplied to Khartoum State. However, limited studies have been carried out to evaluate the management practices in the study area. Thus the main objective of this study is to assess the management practices in the dairy farms of Eastern Nile and Khartoum North localities, Khartoum State, Sudan. The study also aims to determine the problems and constraints of the milk production sector in the study area.

## MATERIAL AND METHODS

### Study area:

The study was conducted in Khartoum State, Sudan, specifically at four administrative units of Khartoum North and Eastern Nile provinces. The included administrative units (regions) were Tibna, Edbabiker, South Silate and Elafon regions. The average minimum and maximum temperatures of the study area during the study period ranged from 16-31°C in January to 27-42°C in May (Climate Zone, 2012). Both agro-ecological zones have high dairy cattle concentration and are major producers of milk in Eastern Nile.

### Data Collection:

The study started with a survey targeting the local dairy producers. The Single-visit, multiple-subject approach of data gathering described by (Gilbert et al., 1980) was used in this study. A questionnaire covered seventy randomly selected milk producers who accounted for 18% of the total number of milk producers in the area was used in the study. The owners and workers of the visited farms were individually interviewed and the collected data were recorded. Moreover, observations regarding the housing system, conditions of the animals in barns and other issues that may not be reported by the respondents were also recorded.

Descriptive statistics analysis was carried out for the collected data in terms of percentage.

## RESULTS AND DISCUSSION

### Management in study area:

Almost all farm owners in the study area were following the same management system. The study revealed that 47% of the owners adopted modern type of animals keeping and 53% adopted a traditional type (Table 1). Seventy six percent of the traditional type farms' breeders depend on straw in building their barns roofs because they believed that straw roof has a role in avoiding worms, while 19% and 5% depend on reeds and iron scrap, respectively. Most of the barns in study area were shaded. Regarding fencing, 61% of the owners constructed their fences using iron while 26%, 10% and 3% used mud bricks, bricks and wire + zinc, respectively (Table 1). On the other hand, the entire surveyed farms floors were not concreted because the breeders believe that the concrete floor is harmful for their animals' feet. The above results were supported by Kulneff (2006) who studied the dairy management system in relatively modern systems in Khartoum State and reported that the animals were housed in pens on the ground, surrounded by either mud walls or iron fences and with access to roofs for shadow.

The weaned female calves were kept as replacement heifers, as for the males, there were disposed by sale, and only one or two were retained for the purpose of breeding. The returns from the sale of calves often used to cover the costs of feeding. Similar results were reported by Mustafa (2008) who stated that the small and large commercial farmers used the same calves' management system regardless of the studied regions. He also reported that weaned female calves were kept as replacement heifers, while almost all male calves were culled, exchanged or sold to neighboring smallholder dairy farmers. The result is also in line with the findings of Hanyani-Mlambo et al. (1998) who studied the socio-economic aspects of smallholder dairying in Zimbabwe.

The housing of calves was in groups (Figure 1A). Calves generally looked thin. The number of calves kept together was large and all calves, pre weaning, were kept in the same pen. The pens were on soil and, in some herds, with walls of mud, allowing infectious agents to persist in the environment. Poor growth and health problems in these animals are probably caused by restricted suckling in combination with scanty feeding, poor access to water in some cases and high disease pressure. Some of the farms only kept cattle and others kept several other species beside cattle, in this case all animals were kept together. These results were similar to that reported by Kulneff (2006). The majority of farm owners relied on the naming system to identify their animals by giving them different names (Figure 1A). As for keeping their records, 74% of the farms have records, but these records are not recorded properly and did not contain sufficient information, while the rest lack records. Seventy-nine percent of farmers were culling their animals on the basis of aging and decline of production. Most of the owners did not practice weaning and abandoned their calves with their mothers (Figure 1B). Restricted suckling was the system found to be practiced by almost all owners. Milking is usually done twice a day; early in the morning and in the



To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res*., 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

evening (Figure 2). Milking is commonly done outside, beside a restraining wooden post erected near the main kraal or under a tree. The calf is allowed to suckle to stimulate milk let down and the cow was then milked. The calf is allowed to suckle again before being tethered away from the cows. In most cases no attempt is made to wash the udder before milking. This may be due to the practice of allowing the calf to suckle before milking. A bad milking practice which is commonly observed is that of the milker dipping his fingers into the milk as a means of lubricating the teats during milking. Similar observations were reported by FAO (1990) and Lyimo et al. (2004) in Southern and Eastern Africa.

The main obstacles facing calves rearing reported by the owners were calves diseases and poor growth of calves. Others were inadequate knowledge on calf rearing and mortality. As for overall evaluation of the management system in study area, the management system in more than 50% of the farms was judged as very bad (Figure 3).

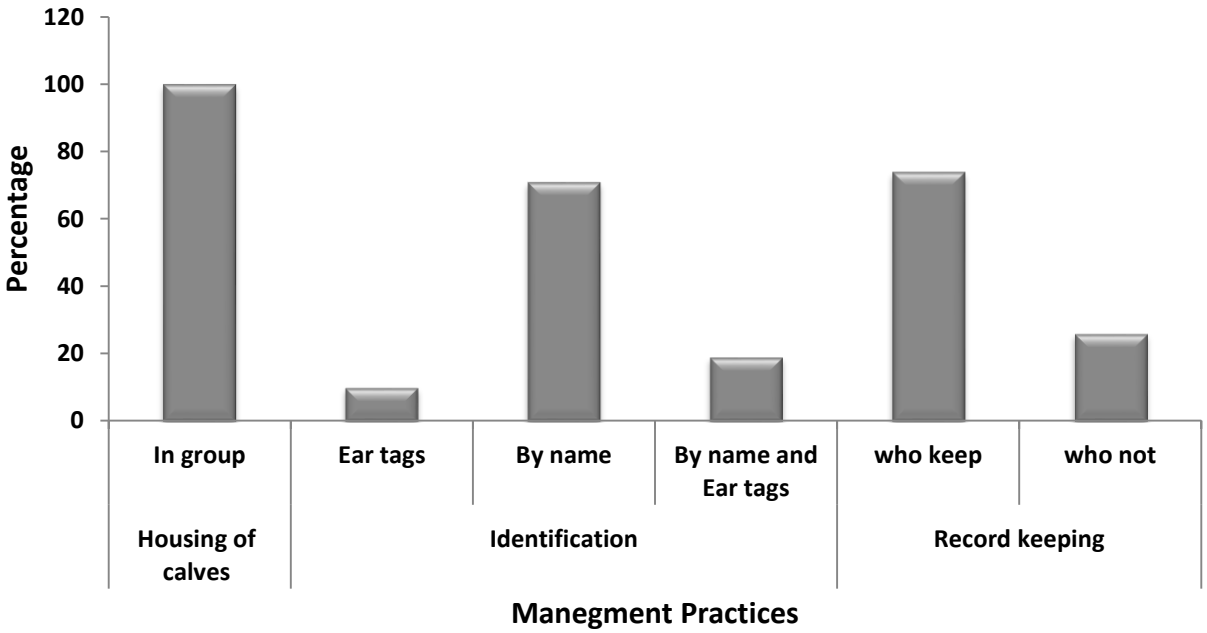



**Figure 1A.** Farm Management in the study area (N=70)

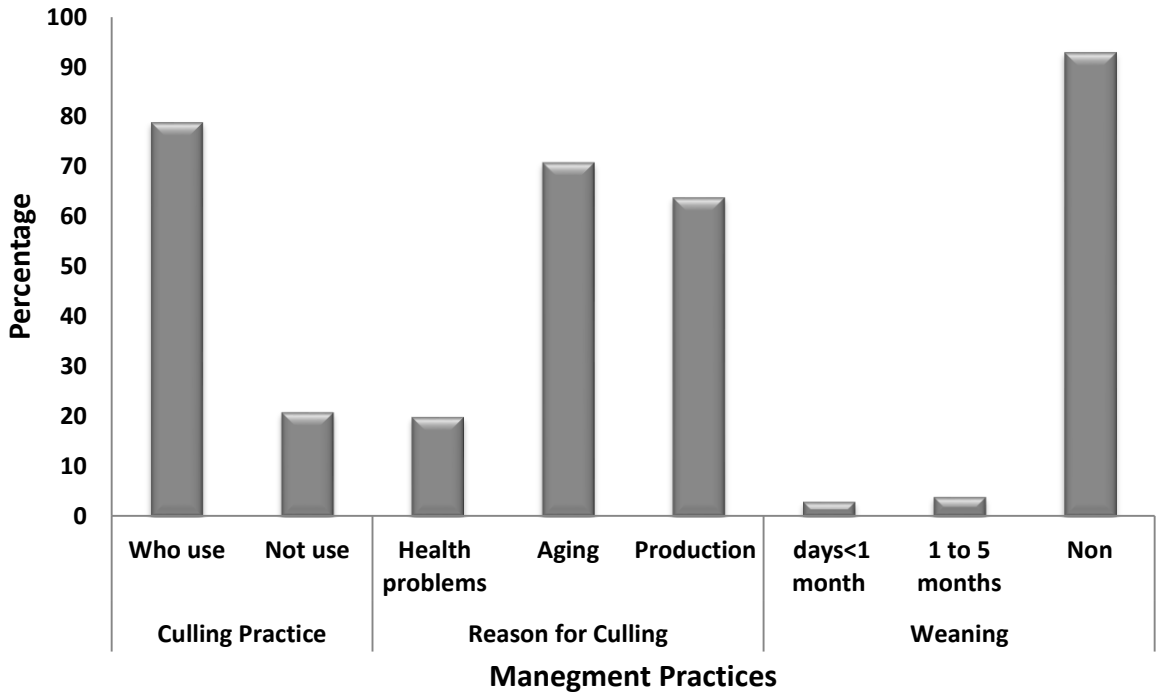



**Figure 1B.** Farm Management in the study area (N=70)



To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res*., 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

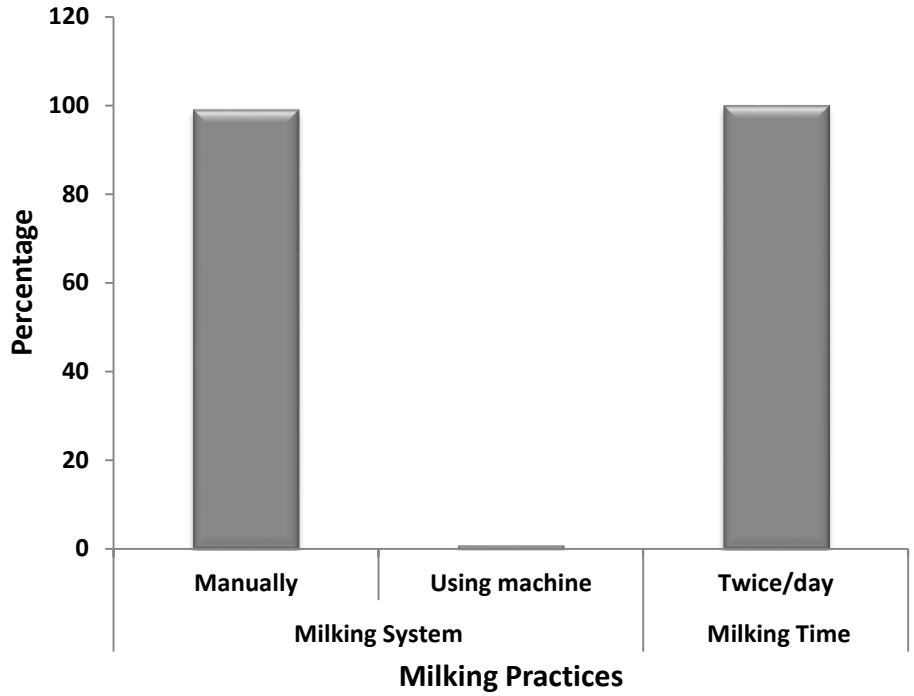



**Figure 2.** Milking system and milking frequency in study area (N=70)

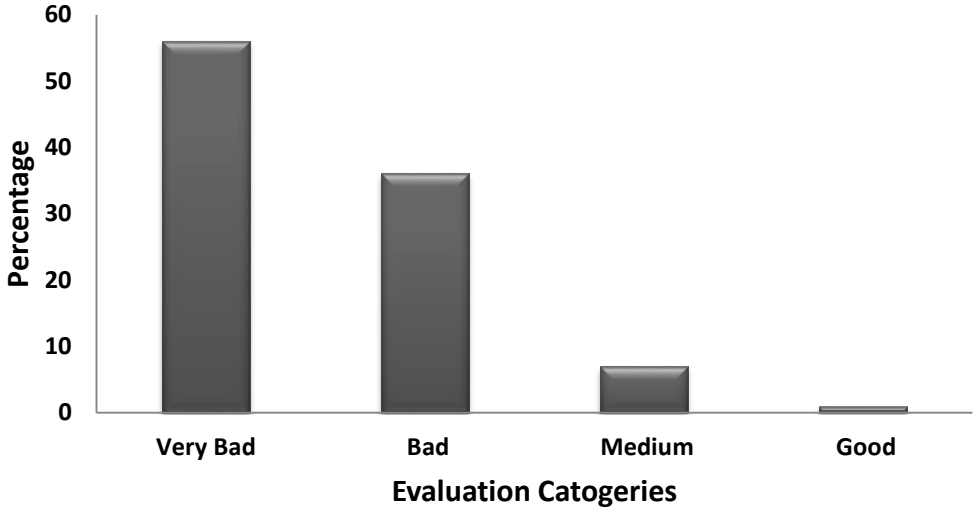



**Figure 3.** Evaluation of the Current Management System in Study Area (N=70)

**Body Condition Score**

Body condition score (BCS) is a method of evaluating fatness or thinness in cows, according to a five-point scale and used the score to fine-tune dairy herd nutrition and health. Evaluation of BCS is recommended because it reflects the nutritional status and energy balance in dairy cows (Kim and Suh, 2003). Eighty five percent of the farms cows had higher BCS than recommended (obese cows), while 4% had BCS lower than physiologically accepted (Figure 4). These finding are consistent with these reported by Mustafa (2008). This result could be due to the lack of specific feeding plans. Concentrate was given to dairy herds irrespective of physiological status of the animal. The Feed quantities were not weighed and sometimes cows given more than their actual requirements. On the other hand, the fertility problems in the study area could be attributed to the higher BCS. Mongeon (2011) reported that the successful pregnancy can be achieved earlier when the BCS low point and reserve replenishment happens early in lactation. It also seems that the optimal BCS at the onset of the breeding period should range between 3.0 and 3.5. For cows above or below this range, successful heat detection decreases rapidly. Cows with high BCS at calving have a much greater risk of coming down with metabolic problems later on. He also reported a 30% increase in the risk of milk fever if a cow's BCS was greater than 3.5 at calving. Similarly, a doubling of ketosis risk was recorded in dairy cows calving at a BCS greater than 3.5 compared to cows calving at 3.5. Generally, over-



To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res.*, 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

conditioning-BCS greater than 3.5 increased risk of metabolic disorders around calving time. BCS has also been linked to lameness. Recent findings suggest previous BCS recommendations need to be lowered slightly. Optimal BCS at calving should range between 3.0 and 3.25, and the loss of BCS after calving should be no more than 1 point to a lowest score of 2.25 quoting by Mongeon (2011). High BCS before calving, as well as marked losses in body condition after calving are associated with metabolism related diseases like fatty liver, decreased fertility and increased culling rates (Hayirli et al., 2002; Šamanc et al., 2010).

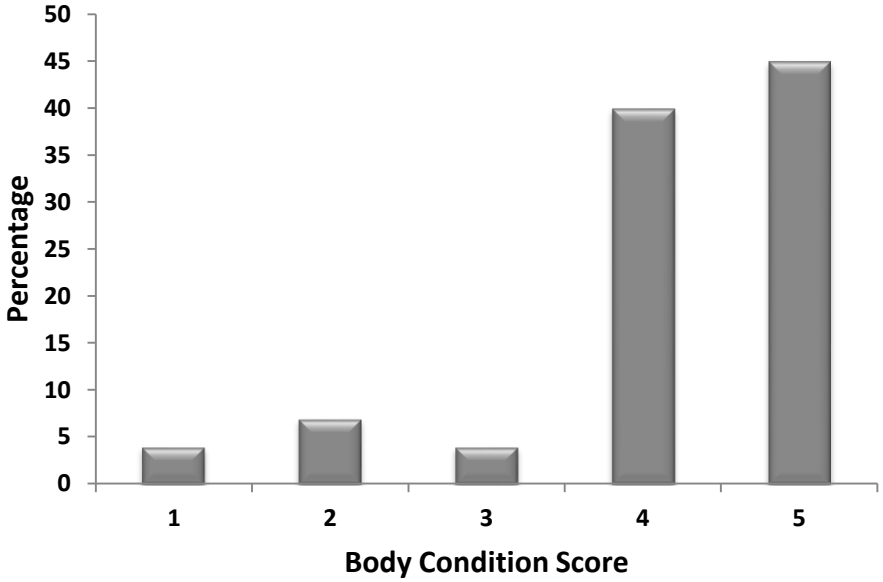



**Fig 4.** Body Condition Score (BCS) of milking cows in study area (N=70)

**Animal health and common diseases in study area**

Livestock keepers in the study area, irrespective of the location in the four regions had listed a wide range of diseases. The percentage of the infectious diseases such as Mastitis, Foot and Mouth disease, Contagious Bovine Box and Pleuro–phneumonia that frequently occurred in the milk herd in both small and large scale livestock keepers were 99%, 51%, 13% and 11%, respectively (Figure 5). Other diseases of importance were Bloats 4%, hoof problems 3% due to bad management and milk fever 1%. These finding are partly complying with these reported by Mustafa (2008) who found that infectious diseases such as Foot and Mouth diseases, Contagious Bovine and Pleuro–phneumonia had frequently occurred in the herd with a percentage of 60%, he also found Mastitis with a percentage of 35.6% and Diarrheas and Bloats with a percentage of 24.4%.

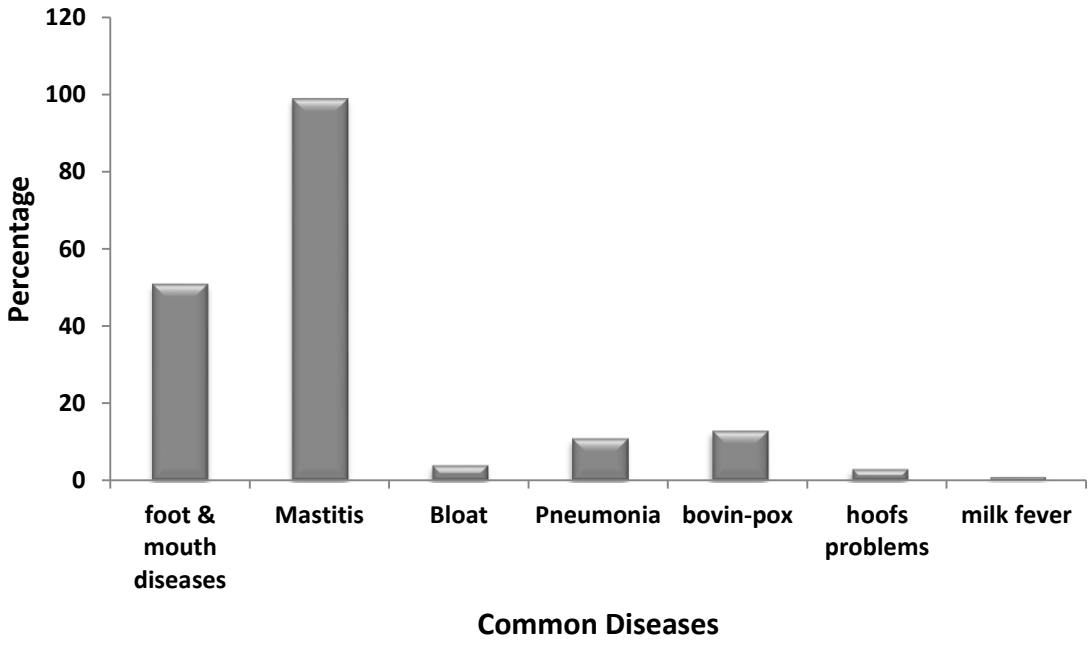



**Figure 5.** Percentage of common diseases in study area



To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res.*, 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Musa et al. (2006) also found the incidences of infectious diseases in cows in Butana cattle area at a rate of 24% for Foot and Mouth diseases and 40% for Contagious Bovine and Pleuro–phneumonia. The same study also reported a similar finding for Diarrheas. Mustafa (2008) observed that Foot and Mouth disease, Rinderpest and Hemorrhagic septicemia in ruminants are among the most infectious diseases found in the traditional production system in Khartoum urban and peri-urban regions.

Diarrhea and Jaundice were the major causes of mortality in suckling calves in study area (Table 2). Diarrhea and Jaundice together are responsible for 36% of the suckling calves mortality, while Diarrhea, Jaundice and other problems were responsible for 33%, 13% and 15%, respectively. As the ground was soil in the study area, infectious agents may remain in the permanent pen and thus put a high disease pressure on new calves introduced into the herd. This result is in accordance with the result of Kulneff (2006). Because the majority of farmers in the study area did not wean the calves which remain with their mothers until it gives birth for the second time, the colostrums may not be enough to the newborn calves and this might weaken their immunity against diseases. This might be another reason for the high mortality rate of the suckling calves in the study area as colostrum is an important factor in developing immunity. Lidfors (1996) found lower mortality rates for calves that received their colostrum by suckling their mothers compared to calves that received colostrum from an open bucket.

Disease prevention has to be adjusted to the management system and the disease pattern in the herd (Payne and Wilson, 1999). The ways available to protect livestock from infectious diseases are by increasing the host's defense and by preventing the animals from meeting the contagion. Through breeding regimes, animals have become more tolerant or even resistant to some diseases. Generally, by providing good hygienic conditions, the disease pressure can be diminished (Payne and Wilson, 1999). In a housed environment, other ways of spreading diseases has to be taken into consideration. Many animals then have close contact in a limited area. The walls and floors may harbour infectious agents. Other ways of controlling diseases are by vaccination, vector control (e.g. dipping) and for young animals by securing colostral immunity (Algers et al., 2009).

No separation between groups, permanent pens directly on the soil, and poor watering and feeding regimes, cause many problems for the health of animals and thus productivity and income for the farmers. Many of these problems could be diminished by extension activities.

### Major constraints facing small-scale dairy farms

The respondents mentioned three major problems afflicting the dairy sector which were the high cost of nutrition, prices of drugs and lack of new technologies (Table 3). Also they stated some other obstacles facing the dairy sector including location, taxes, marketing and financing. This is in accordance with the finding of Mustafa (2008) who found that the major constraints for livestock production were high prices of concentrates, high taxes, poor extension coverage, small land area and pressures from governmental health authorities. Other constraints included lack of utilizable technologies, lack of capital, poor local genes, and poor management practices. Also Masangi (1998) and Leslie et al. (1999) reported that animal feed is a major constraint for zero-grazed dairy cattle. The results also goes in line with the finding of Musa et al. (2006) who reported that Kenana and Butana cattle herders stressed that lack of livestock feed was the most important limiting factor for productivity of their cattle. However, Habeeballa (1996) attributed high concentrates prices to export of industrial by-products and high prices of green fodder to seasonal factors. In some cases especially during fall and festivals low milk prices and high concentrates prices acted as a disincentive, forcing producers to restrict their feeding.

### Problems of dairy farms observed in the study area

Many problems were observed in the study area including lack of extension services (70%), poor veterinary services (63%), availability of water (44%), spread of ticks (30%) and fertility problems (30%). In addition to some other minor problems like obesity, extreme emaciation, over feeding and expensive feed components. Some of the studied farms provided different types of concentrates per day in order to reduce the feeding cost (Table 4). Moreover some farms have large numbers of milking cows which were milking manually.

Mustafa (2008) reported that only 5.6% of the respondents indicated the availability of extension services from governmental extension authorities. The reason behind poor government extension coverage could be due to the negligence of government authorities to this important sub-sector. In this context and regarding the veterinary services, El-Sammani et al. (1996) reported that the high incidence of infectious diseases and the high cost of veterinary drugs could be attributed to the liberalization of the economy and the sudden shift from completely government subsidized to privatized veterinary services provided at market price.

For the tick problems, Jongejan et al. (1987) reported that the greater number of ticks in Khartoum than in other locations is probably due to the dense livestock population in the area, which would have led to a high pick-up


To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res.*, 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

rate of ticks by cattle that are always kept in pens. Cattle in the other locations are not confined in pens because of the nomadic life of cattle owners.

**Table 1** - Type of Barns, fences and floor in the study area

| Items | Types | % |
|---|---|---|
| Type of Barns | Modern | 47% |
| | Traditional | 53% |
| Traditional | Straw | 76% |
| | Reeds | 19% |
| | Iron scrap | 5% |
| Shading | Yes | 96% |
| | No | 4% |
| Fencing | Barbed wire + Zinc | 3% |
| | Iron fence | 61% |
| | Mud brick wall | 26% |
| | Bricks | 10% |
| Floor type | Soil | 100% |

**Table 2** - Percentage the causes of mortality in Suckling calves in study area

| Mortality | % |
|---|---|
| Diarrhea | 33% |
| Jaundice | 16% |
| Diarrhea & Jaundice | 36% |
| Others | 15% |
| Total | 100% |

**Table 3** - Major constraints encountered in small-scale dairy farming

| Major constraints | % of the studied farms |
|---|---|
| Funding | 4% |
| Cost of Nutrition | 100% |
| Technical | 100% |
| Prices of drugs | 100% |
| Marketing | 6% |
| Tax | 13% |
| Location | 14% |

**Table 4** - Problems of Dairy Farms Observed in the study Area

| Problems | % of studied farms |
|---|---|
| Lack of Extension services | 70% |
| Veterinary services | 63% |
| Availability of water | 44% |
| Fertility problems | 30% |
| Ticks | 30% |
| Over Feeding | 21% |
| Obesity | 20% |
| Providing different types of concentrates per day | 19% |
| Vaccination | 14% |
| Lacking of milking parlour | 11% |
| Extreme emaciation | 8% |
| Availability of workers | 6% |
| Expensive components | 4% |

Among the constraints facing productive and reproductive performance of dairy cows, Duguma et al. (2012) reported that the age at first calving was affected by shortage of feed, feeding and disease and the combined effect of feeding, disease and breeding management. The respondents in this study reported that feed shortage and interactions of nutrition, health, housing and management level were major problems affecting milk production in the neighboring country Ethiopia. Age at first calving was reported to be influenced by the onset of puberty, which itself is affected by environment, breed type, season and herd effects (Mukasa-Mugerwa, 1989). Duguma et al. (2012) reported that dry season feed shortage was the main reason for seasonal fluctuation of milk production.


To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res.*, 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Poor nutrition increases the susceptibility of dairy cows to health problem and physiological stress which results in lower production, much longer calving intervals, as well as problems in fertility (Reda, 1999; De Boer, 1999).

It can be concluded that farms suffer from poor management and the impact of the spread of disease, especially Mastitis and Foot and mouth disease, in addition to the high mortality rate of calves due to Diarrhea and Jaundice diseases. The dairy sector completely lacks the extension services, as well as veterinary services as the majority of the farm owners buy the medicines and treat their animals by themselves.

## REFERENCES


Algers B, Blokhuis H J, Bøtner A, Broom DM, Costa P, Domingo M, Greiner M, Hartung J, Koenen F, Müller-Graf C, Morton DB, Osterhaus A, Pfeiffer DU, Mohan R, Roberts R, Sanaa M, Salman M, Sharp JM, Vannier P and Wierup M (2009). Scientific opinion of the panel on animal health and welfare on a request from European commission on the overall effects of farming systems on dairy cow welfare and disease. European Food Safety Authority, The EFSA Journal, 1143: 1–38.

Bonnier P, Maas A and Rijks J (2004). Dairy cattle husbandry. Agromisa Foundation. Second edition. Digigrafi, Wageningen. the Netherlands, ISBN: 90-77073-66-3.

Climate Zone (2012). Climate information for Sudan. Climatezone.com. 12 Jul. 2012. http://www.climatezone.com/climate/sudan/fahrenheit/khartoum.htm.

De Boer AJ (1999). Socio-Economic aspects of smallholder dairy farmers. In smalholder dairying in the tropics. Addis Ababa. International Livestock Research Institute ILRI. 25.

Duguma B, Kechero Y and Janssens GPJ (2012). Productive and reproductive performance of Zebu X Holstein-Friesian crossbred dairy cows in Jimma Town. Oromia, Ethiopia. Global Veterinaria, 8 (1): 67–72.

El-Sammani MO, Zaroug MG and Awad F (1996). Review of OXFAM livestock programme. OXFAM U.K., Khartoum, Sudan.

FAO (1990). Milking conditions and hygiene. In: The technology of traditional milk products in developing countries. FAO Animal Production and Health Papers 85.

Gilbert EH, Norman DW and Winch FE (1980). Farming system research: A critical appraisal. MSU Rural Development Papers 6. Department of Agricultural Economics, Michigan University, East Lansing, Michigan, USA. pp: 135 + xiii.

Habeeballa AM (1996). Assessment of dairy farming practices in Eastern Nile, Khartoum State. M.Sc. Thesis, Faculty of Animal Production, University of Khartoum, Sudan.

Hanyani-Mlambo BT, Sibanda S and Østergaard V (1998). Socio-economic aspects of smallholder dairying in Zimbabwe. Livestock Research for Rural Development 10(2): 1–14.

Haskell MJ, Rennie LJ, Bowell VA, Bell MJ and Lawrence AB (2006). Housing system, milk production and zero-grazing effects on lameness and leg injury in dairy cows. Journal of Dairy Science 89(11):4259–4266

Hayirli A, Grummer RR, Nordheim EV and Crump PM (2002). Animal anddietary factors affecting feed intake during the prefresh transition period in Holsteins. Journal of Dairy Science, 85(12): 3430–3443.

Jongejan F, Zivkovic D, Pegram RG, Tatchell RJ, Fison T, Latif AA and Paine G (1987). Ticks (Acari: Ixodidae) of the Blue and White Nile ecosystems in the Sudan with particular reference to the Rhipicephalus sanguineus group. Experimental and Applied Acarology. 3(4): 331–346.

Kim IH and Suh GH (2003). Effect of amount of body condition loss from the dry to near calving periods on the subsequent body condition change, occurrence of postpartum diseases, metabolic parameters and reproductive performance in Holstein dairy cows. Theriogenology, 60: 1445–1456.

Kulneff C (2006). A comparative study of urban and rural dairy management systems in Sudan. Swedish University of Agricultural Sciences degree project 2006: 56. Faculty of Veterinary Medicine. Animal Sciences Uppsala. 22 Jul. 2012 http://ex-epsilon.slu.se:8080/archive/00000875/01/CKulneff.pdf

Leslie J, Swai ES, Karimuribo E and Bell C (1999). Tanga and Southern Highland, dairy development programmes: Socio- Economic aspects and farmer perception of dairy cattle keeping and animal diseases, DFID/NRRD -Animal Health Research Programme23–45.

Lidfors LM (1996). Behavioural effects of separating the dairy calf immediately or 4 days postpartum. Applied Animal Behaviour Science 49(3): 269–283.

Lyimo HLN, Mtenga LA, Kimambo AE, Hvelplund T, Laswai GH and Weisbjerg MR (2004). A survey on calf feeding systems, problems and improvement options available for the smallholder dairy farmers of Turiani in Tanzania. Livestock Research for Rural Development, 16 (4). 22 Jul. 2012 http://www.lrrd.org/lrrd16/4/lyim16023.htm

Masangi BS (1998). The effect of feeding on the performance of crossbred dairy cattle in the smallholder dairy system along the coast of Tanzania. Ph.D Upgrada Report, Department of Agriculture, University of

Reading, UK.

Mongeon M (2011). Body condition scoring. Ministry of Agriculture, Food and Rural Affairs, Ontario RUL: http://www.omafra.gov.on.ca/english/livestock/dairy/facts/bodycondscoring.htm.

Mukasa-Mugerwa E (1989). A review of reproductive performance of female Bos indicus (Zebu) cattle. ILCA Monograph No. 6. International Livestock Center for Africa, Addis Ababa, Ethiopia. http://www.fao.org/wairdocs/ilri/x5442e/x5442e00.htm

Musa LMA, Ahmed MKA and Peters KJ (2006). On farm characterization of Butana and Kenana cattle breed production systems in Sudan. Livestock Research for Rural Development 18, Article 177.

Mustafa EA (2008). Surveys on some livestock keeping practices in urban and peri-urban parts of Khartoum North Province, Sudan. Ph.D. Thesis, University of Khartoum, Sudan.

Payne WJA and Wilson RT (1999). An introduction to animal husbandry in the tropics. 5th ed. Cambridge: Blackwell Science Ltd.

Reda T (1999). Feeding of a crossbred dairy cow. Addis Ababa, Ministry of Agriculture (MOA), 26.

Šamanc H, Kirovski D, Jovanović M, Vujanac I, Bojković-Kovačević S, Jakić-Dimić D, Prodanović R and Stajković S (2010). New insights into body condition score and its association with fatty liver in Holstein dairy cows. Acta Veterinaria. Belgrade, 60(5): 525–540.

Wagner-Storch AM, Palmer RW and Kammel DW (2003). Factors affecting stall use for different free stall bases. Journal of Dairy Science, 86(6): 2253–2266.

West JW (2009). Managing and feeding lactating dairy cows in hot weather. Extension Dairy Scientist. Cooperative Extension, College of Agricultural and Environmental Sciences, the University of Georgia, U.S. http://extension.uga.edu/publications/files/pdf/B%20956_2.PDF.



To cite this paper: Saeed S.Y and Fadel Elseed A.M.A 2015. Management practices of dairy farms; case study: Khartoum north and eastern Nile localities, Khartoum, Sudan. *Online J. Anim. Feed Res*., 5(1): 09-17.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

*Online Journal of Animal and Feed Research*

*Volume 5, Issue 1: 18-21; Jan 25, 2015* ISSN 2228-7701

# NUTRITIVE VALUE OF RUBBER SEED (*Hevea brasiliensis)*

**Md. Emran HOSSAIN*[1], Mohammad Hasanul KARIM[2], Sanjida ALAM[3] and Sabuj Kanti NATH[2]**

[1]*Department of Animal Science and Nutrition, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*
[2]*UG student, Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*
[3]*Department of English Language and Literature, University of Science & Technology Chittagong, Bangladesh*
[4]*Department of Animal Nutrition, Faculty of Animal Husbandry, Bangladesh Agricultural University, Mymensingh, Bangladesh*
*Email: emrancvasu@yahoo.com

**ABSTRACT***:* The study was undertaken to find out the chemical composition of rubber seeds (*Hevea brasiliensis*) available in Bangladesh. *Hevea brasiliensis* seeds were collected directly from 200 rubber trees of the rubber garden in the Bandarban area under standard random sampling technique. Seeds were decorticated, ground and dried in hot air oven. Chemical analyses of the samples were carried out in triplicate for moisture, dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), ether extract (EE) and ash in the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Metabolizable energy (ME) was calculated mathematically by using standard mathematical formula. Results indicated that, decorticated *Hevea brasiliensis* seeds contained 85.7% DM, 26.1% CP, 43.0% CF, 13.8% NFE, 11.0% EE and 1.8% ash. ME contents in in the seeds was 2101.1 kcal/kg DM. Since, decorticated rubber seeds contained substantial amount of metabolizable energy and proximate components, therefore it could be assumed that, like other unconventional feeds, it might be a promising feed resource for livestock.

**Keywords:** Chemical Composition, *Hevea brasiliensis*, Metabolizable Energy, Nutritive Value.

ORIGINAL ARTICLE
pii: S222877011500003-5
Received 05 Jan. 2015
Accepted 21 Jan. 2015

## INTRODUCTION

The rubber tree (*Hevea brasiliensis*) is a perennial plantation crop indigenous to South America and a cultivated industrial crop in Southeast Asia since 1876 (Abdullah and Salimon, 2009). The British planters first introduced it in Bangladesh in the early twentieth century and commercial plantation was started in 1961 by the government in Chittagong and Sylhet hilly regions. Later on, plantations were expanded in Chittagong Hill Tracts and Madhupur by the government and public enterprises. The British and some other private companies also planted rubber trees in the fellow lands of tea estates. At present about 25,000 hectare of land is under rubber plantation in Bangladesh and annual production is about 7,500 tons against 20,000 tons of the total demand of natural rubber (Anonymous, 2006). Rubber tree starts to bear fruit at four year of age. Each fruit contains three or four seeds, which fall to the ground when fruit ripens and splits away. Each tree yields about 800 seeds (5 kg/tree annually) twice a year (Bressani et al., 1983). Rubber plantation is estimated to produce about 800-1200 kg rubber seed/ha/year which is normally regarded as waste in Bangladesh. There is no doubt that at this moment persistent shortage of conventional feedstuffs for livestock in Bangladesh is due to inadequate production of farm crops to meet their growing demands at commercial scale. These scenario forcing animal nutritionists to evoke and intensify research for potentially useful but neglected crop products like rubber seed (*Hevea brasiliensis*) obtained from rubber tree (Babatunde et al., 1990).

The Malaysian, Nigerian and Indian rubber seeds are rich in oil (10.1-68.5%), crude protein (14.9-34.1%), ash (2.4-3.1%) linoleic acid, lysine (4.26 mg/16gN), leucine (6.81 mg/16gN), isoleucine (3.28 mg/16gN), valine (7.08 mg/16gN), threonine (3.72 mg/16gN), methionine (1.37 mg/16gN) and other non-essential amino acids. Rubber seed oil is very rich in linolenic and linoleic acids (Babatunde and Pond, 1987b). Malaysia, Indonesia, Nigeria and Srilonka has already extracted and used rubber seed meal in livestock feed. However, no systematic studies have so far been carried out in Bangladesh to find out the nutritive values of rubber seeds and feasibility to explore it as



To cite this paper: Hossain M.E., Karim M.H., Alam S. and Nath S.K. 2015. Nutritive value of rubber seed (Hevea Brasiliensis). *Online J. Anim. Feed Res.*, 5(1): 18-21.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

feed in livestock industry. Therefore, current study aims to estimate the nutritive value of decorticated rubber seeds collected from different rubber gardens available in Bangladesh.

## MATERIAL AND METHODS

### Study area

Most of the rubber gardens of Chittagong Hilly areas are located in Cox's bazaar and Bandarban areas. Therefore, the current study was conducted in randomly selected three rubber gardens of Bandarban district. The study area has a latitude of 22°21'N, longitude 91°49'E and elevation of 29 m. The area is fairly hot with annual average temperature of 25.1 °C. The variation of daily average temperature is 8.8 °C. Mean monthly temperature has a variation of 9 °C the hottest month is May having a mean temperature of 28 °C. The coolest month is January which has a mean temperature of 19 °C. The average annual relative humidity of the area is 73.7% and average monthly relative humidity ranges from 58% in January to 86% in August. The area has an average of 2735 mm rainfall per year.

### Collection of sample

The rubber tree begins to produce fruit at 4 years of age. A fruit contains 3 to 4 seeds, which consist of a hard shell, which is brown or black with some white spots and a soft white kernel. The proportion of the kernel is about 50% of the total weight of the seed. The soft kernel is used to produce oil and the by-product is rubber seed meal (Dong, 2003). Dried rubber seeds containing intact kernel were collected from 200 trees of the Bandarban area under standard random sampling technique. Total 10 kg of rubber seeds were collected for a period of 30 days. Seeds were packed in airtight sacks and sent to the Animal Nutrition Laboratory, Chittagong Veterinary and Animal Sciences University for chemical analysis.

### Preparation of sample

Entire dried seeds were decorticated, kernels were ground (1-3 mm sieve) and dried in hot air oven. Dried ground kernels were blended to powder. Later on, it was mixed properly and exposed to shade to cool down. Samples were wrapped up by polythene bag and preserved in the laboratory for chemical analysis.

### Analysis of sample

Chemical analyses of the samples were carried out in triplicate dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash (TA) in the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh as per AOAC (2006).

### Calculation of Metabolizable Energy (ME)

Metabolizable Energy (ME) was calculated from proximate components by mathematical formula as per Lodhi et al. (1976).

## RESULTS AND DISCUSSION

### Dry matter (DM)

The DM content of rubber seeds determined in this study was 95.7% (Table 1). The result is in close agreement with earlier studies where it was 96.1% (Eka et al., 2010), 96.1% (Onwurah et al., 2010), 96.4% (Giok et al., 1967), 97.0% (Ukhun and Uwatse, 1988) and 94.2% (Madubuike et al., 2006). However, the result differs with the findings of other investigators who reported it 91.0% (Oyekunle and Omode, 2008), 90.4% (Ly et al., 2001) and 90.6% (Babatunde et al., 1990).

### Crude protein (CP)

The crude protein content of rubber seeds determined in this study was 26.1% (Table 1). The result is in line with previous studies where it was reported to be 23.6% (Chanjula et al., 2011), 22.3% (Onwurah et al., 2010), 28.3% (Babatunde et al., 1990), 27.4% (Narahari and Kothandaraman, 1984) and 27.0% (Giok et al., 1967). However, the result differs with the findings of other investigators who reported it 17.4% (Eka et al., 2010), 14.9% (Ly et al., 2001), 18.2% (Achinewhu, 1986) and 11.4% (Bressani et al., 1983).

### Total ash (TA)

The TA content of rubber seeds determined in this study was 1.8% (Table 1). The result is similar with studies where it was 2.6% (Onwurah et al., 2010) and 2.4% (Giok et al., 1967). However, the result differs with the findings


To cite this paper: Hossain M.E., Karim M.H., Alam S. and Nath S.K. 2015. Nutritive value of rubber seed (Hevea Brasiliensis). *Online J. Anim. Feed Res.*, 5(1): 18-21.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

of other investigators who reported it 3.1% (Eka et al., 2010; Mmrole, 2008; Ly et al., 2001) and 3.5-5.0% (Ukhun and Uwatse, 1988; Oyekunle and Omode, 2008).

**Ether extracts (EE)**

The EE content of rubber seeds in the present study was 11.0% which is in good comparison with Mmereole (2008) (10.1%). However, this result differs with other researchers who reported it 40.8% (Chanjula et al., 2011); 68.5 % (Eka et al., 2010); 42.5% (Onwurah et al., 2010); 28.4% (Ly et al., 2001); 28.8% (Babatunde et al., 1990); 21.8% (Achinewhu, 1986); 24% (Narahari & Kothandaraman, 1984) and 32.3% (Giok et al., 1967). The possible reason for high ether extract content could be either due to variation in the proportion of kernel content of the seeds or preparation techniques of rubber seed meal.

**Table 1 -** Nutritive value of decorticated rubber seed meal available in Bangladesh (N=200)

| Ingredient | ME | DM | CP | CF | NFE | EE | ASH |
|---|---|---|---|---|---|---|---|
| Rubber seed | 2101.1 | 85.7 | 26.1 | 43.0 | 13.8 | 11.0 | 1.8 |

DM=Dry matter, ME=Metabolizable energy, CP=Crude protein, CF=Crude fibre, NFE=Nitrogen free extract, EE=Ether extract

**Table 2 -** Nutritive value of rubber seed meal available worldwide

| Investigators | ME | DM | CP | CF | NFE | EE | TA |
|---|---|---|---|---|---|---|---|
| Chanjula et al., 2011 | 4674.8 | - | 23.6 | - | - | 40.8 | - |
| Eka et al., 2010 | - | 96.1 | 17.4 | | - | 68.5 | 3.1 |
| Onwurah et al., 2010 | - | 96.1 | 22.3 | - | 29.0 | 42.5 | 2.6 |
| Mmrole, 2008 | 2520 | - | 34.1 | 4.4 | - | 10.1 | 3.1 |
| Ly et al., 2001 | - | 90.4 | 14.9 | - | - | 28.4 | 3.1 |
| Babatunde et al., 1990 | - | 90.6 | 28.3 | - | - | 28.8 | - |
| Achinewhu, 1986 | - | - | 18.2 | 13.7 | 35.7 | 21.8 | - |
| Narahari & Kothandaraman, 1984 | - | - | 27.4 | 15.9 | - | 24.0 | - |
| Giok et al., 1967 | - | 96.4 | 27.0 | - | - | 32.3 | 2.4 |

DM=Dry matter, ME=Metabolizable energy,CP=Crude protein, CF=Crude fibre, NFE=Nitrogen free extract, EE=Ether extract

## CONCLUSION

Rubber seed is a neglected waste but nutritionally promising unconventional feed resource for Bangladesh. Therefore, if rubber seed meal could be incorporated in animal diet, it would reduce production cost of broilers, layers as well as other farm animals. Additionally, rubber seed oil could be exploited for the industrial use of paint and varnish. The seeds contain cyanogenetic glycosides but this disadvantage can be overcome by proper cooking. The main limitation in rubber seed meal is the presence of hydrocyanic acid up to 540 ppm. However, both heat treatment and storage time can be used to reduce it.

## REFERENCES


Abdullah BM and Salimon J (2009). Physicochemical Characteristics of Malaysian Rubber (*Hevea brasiliensis*) Seed Oil. European Journal of Scientific Research, 31(3): 437-445.

Achinewhu SC (1986). Unconventional sources of food: Chemical composition of rubber seed (*Hevea brasiliensis*). Food Chemistry, 21(1): 17-25.

Anonymous (2006). Problems of Rubber Production in Bangladesh and Their Solutions, Forestry, Environment, Plantation Crops and Permaculture Consultancy and Research. Available from: http://feppcar.org/9/problems-of-rubber-production-in-bangladesh-and-their-solutions [Accessed 11th May, 2013]

AOAC (2006). Official Methods of Analysis of AOAC International. Association of Official Analytical Chemists, 18th edition (Editor: William Horwitz, George W. Latimer), Gaithersburg, USA.

Babatunde GM and Pond WG (1987). Nutritive value of rubber seed (*Hevea brasiliensis*) meal and oil. II. Rubber seed oil versus corn oil in semipurified diets for rats. Nutrition Reports International, 36: 857-864.

Babatunde GM, Pond WG and Peo Jr ER (1990). Nutritive value of rubber seed (*Hevea brasiliensis*) meal: Utilization by growing pigs of semipurified diets in which rubber seed meal partially replaced soybean meal. Journal of Animal Science, 68: 392-397.

Bressani R, Elias LG, Ayuso J, Rosal O, Braham JE and Zuniga J (1983). Nutritive value of protein and oil in rubber seed (*Hevea brasiliensis*). Turrialba, 33: 61-66.

Chanjula P, Wanapat M, Wachirapakorn C, Uriyapongson S and Rowlinson P (2003). Ruminal degradability of tropical feeds and their potential use in ruminant diets. Asian-Australasian Journal of Animal Science, 16 (2): 211-216

Dong DD (2003). Use of rubber seed meal in diets for colored feather chickens. In: Proceedings of Final National Seminar-Workshop on Sustainable Livestock Production on Local Feed Resources (Editors: Reg Preston and Brian Ogle). HUAF-SAREC, Hue City, 25-28 March, 2003.

Eka HD, Tajul Aris Y and Wan Nadiah WA (2010). Potential use of Malaysian rubber (*Hevea brasiliensis*) seed as food, feed and biofuel. International Food Research Journal, 17: 527-534.

Giok LT, Samsudin MD, Husaini BS and Tarwotjo IT (1967). Nutritional value of rubber seed protein. American Journal of Clinical Nutrition, 20: 1300-1303.

Lodhi GN, Daulat Singh and Ichhponani JS (1976). Variation in nutrient content of feedingstuffs rich in protein and reassessment of the chemical method for metabolizable energy estimation for poultry. Journal of Agricultural Science, 86(2): 293-303.

Ly J, Ty C and Phiny C (2001). Evaluation of nutrients of rubber seed meal in Mong Cai pigs. Livestock Research for Rural Development, 13: 2.

Madubuike FN, Ekenyem BU and Tobih KO (2006). Performance and cost evaluation of substituting rubber seed cake for groundnut cake in diets of growing pigs. Pakistan Journal of Nutrition, 5(1): 59-61.

Mmereole FUC (2008). The Effects of Replacing Groundnut Cake with Rubber Seed Meal on the Haematological and Serological Indices of Broilers. International Journal of Poultry Science, 7 (6): 622-624.

Narahari D and Kothandaraman P (1984). Chemical composition and nutritional values of para-rubber seed and its products for chickens. Animal Feed Science and Technology, 10(4): 257-267.

Onwurah INE, Otitoju O, Njoku OU, Okafor FC and Obidiegwu C (2010). Nutritional value of rubber seed flour for poultry feed-stock, using adult insect Tribolium castaneum as a model. Archives of Applied Science and Research, 2 (5): 422-428.

Oyekunle JAO and Omode AA (2008). Chemical composition and fatty acid profile of the lipid fractions of selected Nigerian indigenous oilseeds. International Journal of Food Properties, 11: 273-281.

Ukhun ME and Uwatse V (1988). Nutritional evaluation of selected Nigerian rubber seed products-a chemical approach. Plant Foods for Human Nutrition, 38: 309-318.



To cite this paper: Hossain M.E., Karim M.H., Alam S. and Nath S.K. 2015. Nutritive value of rubber seed (Hevea Brasiliensis). *Online J. Anim. Feed Res*., 5(1): 18-21.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

*Online Journal of Animal and Feed Research*

*Volume 5, Issue 1: 22-27; Jan 25, 2015* ISSN 2228-7701

# UTILIZATION OF *Limnocharis flava,* AN INVASIVE AQUATIC WEED FROM KUTTANAD WETLAND ECOSYSTEM, KERALA, INDIA AS A POTENTIAL FEEDSTOCK FOR LIVESTOCK

**S. SMITHA CHANDRAN [1]* and E.V. RAMASAMY [2]**

*Department of Chemistry, Amrita Vishwa Vidyapeetham Amritapuri Campus, Clappana P.O, Kollam-690 525, Kerala, India*
*[2]School of Environmental Sciences, Mahatma Gandhi University, Priyadarshini Hills, Kottayam 686 560 Kerala, India*
*Email: smithachandran@am.amrita.edu

**ABSTRACT:** The chemical composition, nutritive value and trace element profiles of *Limnocharis flava*, an emergent aquatic weed during its different growth stages was determined to evaluate as possible cattle feed. Samples were analyzed at three progressive morphological stages of the plant, pre-flowering, flowering and post-flowering. The moisture content, dry matter (DM), ash content, crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen free extract (NFE) and mineral constituents like sodium ($Na^+$) potassium ($K^+$), calcium ($Ca^{2+}$), phosphorous (P) and trace elements like iron ($Fe^{2+}$), copper ($Cu^{2+}$), manganese ($Mn^{2+}$), zinc ($Zn^{2+}$), lead ($Pb^{2+}$), chromium ($Cr^{2+}$ ) nickel ($Ni^+$) and cadmium ($Cd^+$) contents were analyzed. The moisture content, organic matter (OM), acid detergent fiber content increased during maturation, while CP and EE were found decreased with increased growth stage. Only slight fluctuations occurred in Calcium, Potassium, Phosphorous and Sodium contents. The highest values for crude protein, fiber content, NFE and EE were observed at the flowering stage. These plant posses several characteristics which makes it a nutritious feed suitable for domestic livestock, and is recommended to use *L.flava*, particularly at the flowering stage of growth.

**Keywords:** *Limnocharis flava*, Aquatic Weed, Nutritive Value, Chemical Composition.

ORIGINAL ARTICLE
pii: S222877011500004-5
Received 02 Jan. 2015
Accepted 20 Jan. 2015

## INTRODUCTION

Alien weed invasion has been identified as one of the biggest threat to biological diversity around globe. They are aggressive colonizers with flexible habitat requirement and ability to out compete native species. Recent studies reveal that the tropics are the major ecological regions, which often became the victims of biological invasions (Ramakrishnan, 1999). Attempts to eradicate such weeds with chemical, biological, mechanical or hybrid means (Abbasi and Ramasamy, 1999; Abbasi and Nipaney, 1986, Bindu and Ramasamy, 2005) have generally failed throughout the world on a long term basis. These methods succeed only in keeping weed infestations in check at enormous costs (Gajalekshmi et al., 2001). Alternatively, the initial clearance of the weed followed by regular, periodic removal of the regrown weeds, coupled with proper utilization of the harvested weeds seems to be a viable solution to the weed menace. By this means the high productivity of such weeds can be made an asset (Gupta, 1979; Abbasi and Nipaney, 1986; Ramasamy and Abbasi, 1999; Kurian and Ramasamy, 2005). The objectives of this study to determine the potential utilization of an exotic aquatic weed, *Limnocharis flava* as unconventional feed resource to livestock.

*Limnocharis flava* (L) Buchenau, an ornamental plant commonly called yellow bur-head, is a monocot weed in the *Limnocharitacea* family. This emergent weed is a native of tropical and subtropical America and now has invaded in the freshwater ponds, lakes and floodplains of Kuttanad including Vembanad lake, a Ramsar site in Kerala, India. The plant inhabits shallow swamps, ditches, pools and wet rice fields where it grows in more or less stagnant fresh water and rooted in the mud, amidst *Colocassia, Monochoria* and other emergent aquatic plants. It has been reported that this plant has became a pest in rice fields of Ceylon, Indonesia and Malaysia and paddy cultivation is often abandoned due to its serious infestation (Kammathy and Subramanyan, 1967, Bahadur and Raizada, 1968). Another important aspect is its methods of propagation. Fruiting takes place throughout the year and the seeds are produced in abundance. A single fruit produces about 1,000 seeds and a single plant may produce over 1,000,000 seeds per year (Senratna, 1940). It has both vegetative and ramets mode of propagation.

Holm-Nielson (1992) in his monograph on Limnocharitaceae in the "Flora of Neotropica" has reported that *Limnocharis flava* is a neotropic weed, distributed in the northern Argentina and eastern Brazil. Ochse et al. (1931) included the *Limnocharis flava* as an aquatic leafy vegetable in the 'Vegetable of Dutch East Indies'. National Academy of Science, Washington (1976) reported that in Java, juvenile leaves and young plants of *Limnocharis*



To cite this paper: Smitha Chandran S and Ramasamy EV, 2015. Utilization of *Limnocharis flava,* an invasive aquatic weed from Kuttanad wetland ecosystem, Kerala, India as a potential feedstock for livestock. *Online J. Anim. Feed Res.*, 5 (1): 22-27.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

*flava* are a common and much esteemed vegetable. The plant is used as an aquatic ornamental plant in the United States of America. In Sumatra and other places, the plant is used as a fodder for cattle and pigs. The use of *Limnocharis flava* as a livestock feed will help in enhancing the available feed resource and control its spread. A detailed literature search has revealed that several studies have been reported on the nutritional and mineral characteristics of aquatic macrophytes (Harper et al., 1935; Bailey, 1965; Boyd, 1968; 1968a; 1969) but no study has been reported on Limnocharis. Keeping this in view, the present study was carried out to investigate the chemical composition and nutritional characteristics of *Limnocharis flava.*

## MATERIALS AND METHODS

### Collection of Plant samples

Immature *Limnocharis flava* plants (average height of 5-10 cm) were collected from five different sites, within 80 km of Kottayam district, Kerala. In order to obtain information on variation of chemical composition of natural stand, samples were collected from different environmental conditions and all sites represent a wide range of edaphic and climatic conditions. The climatic patterns of these sites are characterized by high precipitation at May, June, July and with little rainfall in summer and winter. Mean daily temperature ranges from 22-310C.

Seedlings of *Limnocharis flava* were grown in a green house in 40x165 cm pots and transplanted to the soil collected from the natural sites where the plants were collected. Sufficient replicates (5 seedlings from each site) were raised. The holes of the pots were sealed in order to provide a water impounded stage similar to the natural conditions and the plants were watered every day. Plant material was harvested for analysis at pre-flowering, flowering and post flowering from the green house plantings.

### Chemical analysis

Whole plant samples were washed and dried in an oven to constant weight at 700C to determine the dry matter (DM) content and were then air equilibrated, ground well and passed through a 1mm screen and stored for later analyses .The samples were analysed for Ash Content, Acid Soluble Ash, Crude Protein, Crude Fiber, Nitrogen Free Extract (NFE), Ether Extract (EE), Phosphorous and Calcium following standard procedures described in AOAC, 1990. A Flame photometer (Systronics make, Model-128) was used for Sodium and Potassium estimation. The trace elements like Iron, copper, manganese, zinc, cadmium, lead, chromium and nickel were determined using a Varian AA Spectra 20 Atomic Absorption Spectrophotometer at the appropriate wavelengths.

### Statistical analysis

Variability of the chemical composition, nutritive value of forage harvested at three stages of maturity were tested for statistical significance by one way analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS, V.II.263 Inc, Chicago, USA).

## RESULTS AND DISCUSSION

The results of the proximate analysis of *Limnocharis flava* at its three morphological stages of growth are presented in Table 1. The moisture content, ash content, acid soluble ash content increased slightly during maturation, while crude protein, nitrogen free extract (NFE) and ether extract (EE) decreased. The ash content was significantly higher at the post flowering stage than the other two stages ($P<0.05$).

**Table 1 - Chemical Composition and Nutritive value (%) of *Limnocharis flava* at three stages of growth.**

| Analyses | Pre-flowering | Flowering | Post-flowering |
|---|---|---|---|
| Moisture content | $87.00 \pm 1.61^a$ | $90.00 \pm 1.97^a$ | $92.00 \pm 3.43^a$ |
| Ash content | $7.80 \pm 0.54^a$ | $9.20 \pm 1.05^a$ | $9.68 \pm 0.36^b$ |
| Acid Soluble ash | $0.60 \pm 0.07^a$ | $0.80 \pm 0.05^a$ | $0.90 \pm 0.07^a$ |
| Crude protein | $13.90 \pm 0.4^a$ | $14.20 \pm 0.51^a$ | $11.44 \pm 0.76^a$ |
| Crude fibre | $5.30 \pm 0.58^a$ | $7.60 \pm 0.51^a$ | $7.94 \pm 0.5^a$ |
| Nitrogen free extract | $65.40 \pm 0.79^a$ | $72.84 \pm 0.44^a$ | $69.40 \pm 0.49^a$ |
| Ether Extract | $6.70 \pm 0.48^a$ | $7.53 \pm 0.44^a$ | $6.88 \pm 0.52^a$ |

Mean of 5 samples ± S.D., Within a row, the values with different letters differ significantly ($P<0.05$)

The mean values of selected inorganic nutrients (dry wt basis) in *Limnocharis flava* at its three stages of growth are presented in Table 2. The Potassium and Sodium concentrations at the pre-flowering and flowering



To cite this paper: Smitha Chandran S and Ramasamy EV, 2015. Utilization of *Limnocharis flava,* an invasive aquatic weed from Kuttanad wetland ecosystem, Kerala, India as a potential feedstock for livestock. *Online J. Anim. Feed Res.*, 5 (1): 22-27.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

stages differ, but there is no significant difference in calcium and phosphorous concentrations at the three stages of maturation (P<0.05). The trace metal composition of *Limnocharis flava* is presented in Table 3. There are significant differences in the concentrations of iron, copper, manganese, zinc, lead and nickel at the flowering and post-flowering stages (P<0.05).

**Table 2** - Selected inorganic nutrient composition (%) in *Limnocharis flava* at three stages of growth.

| Growth stages | Pre-flowering | Flowering | Post-flowering |
|---|---|---|---|
| Calcium | 4.8±0.04[a] | 5.62±0.44[a] | 5.76±0.42[a] |
| Phosphorous | 0.66±0.03[a] | 0.76±0.04[a] | 0.79±0.05[a] |
| Potassium | 0.48±0.05[a] | 1.2±0.36[b] | 1.29±0.46[b] |
| Sodium | 0.0208±0.01[a] | 0.0292±0.004[b] | 0.0348±0.004[b] |

Mean of 5 samples ± S.D. Within a row, the values with different letters differ significantly (P<0.05)

**Table.3.** Trace metal composition of *Limnocharis flava at* the three stages of growth

| Growth stages | Pre-flowering | Flowering | Post-flowering |
|---|---|---|---|
| Iron | 1.91±0.025[a] | 1.98±0.013[a] | 2.23±0.011[b] |
| Copper | 0.020± 0.00002[a] | 0.023±0.00002[a] | 0.025±0.00008[b] |
| Manganese | 0.071±0.00001[a] | 0.076±0.00003[a] | 0.08±0.00004[b] |
| Zinc | 0.002±0.000002[a] | 0.004±0.000001[a] | 0.007±0.000001[b] |
| Lead | 0.019±0.0007[a] | 0.023±0.0013[a] | 0.028±0.0017[b] |
| Chromium | 0.007±0.000003[a] | 0.008±0.000001[a] | 0.01±0.0004[b] |
| Nickel | BDL | BDL | BDL |
| Cadmium | BDL | BDL | BDL |

All values are in ppm. Mean of 5 samples ± S.D. Within a row, the values with different letters differ significantly (P<0.05), BDL – Below Detectable Level

In the present study, the chemical composition, the nutritive value and the trace element profiles of the weed, *Limnocharis flava* at three morphological stages of growth was analyzed and determined. The crude protein, ash content, ether extract, crude fiber and Nitrogen free extract contents on its mature stage resemble that of most other common aquatic plants (Table 4). Boyd (1969) states that protein content declines rapidly with maturity. So harvesting for fodder should be at maximum protein content related to total plant material. This trend is also observed in the present study. The highest value of crude protein, crude fiber, Nitrogen free extract and ether extract were obtained at the flowering stage (Table1). Therefore, the harvesting of the plant at the flowering stage is most recommended.

**Table 4.** Results of Proximate Analysis of some common aquatic weeds.

| Plant | CP | Ash | EE | CF | NFE | References |
|---|---|---|---|---|---|---|
| *Eichhornia crassipes* | 5.70 | 0.62 | 0.40 | 2.90 | 64.2 | Muktar, 1967 |
| *Alternanthera philoxeroides* | 6.40 | 12.0 | 0.80 | 7.50 | 60.8 | Alfrod, 1952 |
| *Pistia stratiotes* | 0.78 | 2.00 | 0.30 | — | — | Boyd, 1969 |
| *Hydrilla verticellata* | 1.37 | 3.2 | 0.27 | — | — | Boyd, 1969 |
| *Lemna Minor* | 17.86 | 1.61 | 2.19 | 11.82 | 66.52 | Linn, 1975 |
| *Ceratophyllum demersum* | 17.00 | 2.18 | 1.51 | 15.2 | 64.11 | Linn, 1975 |
| *Chara vulgaris* | 7.92 | 5.62 | 0.12 | 7.65 | 77.56 | Linn, 1975 |
| *Typha aungustifolia* | 6.92 | 0.93 | 0.98 | 27.32 | 53.46 | Linn, 1975 |
| *Potamageton pectinatum* | 14.05 | 3.22 | 0.09 | 15.64 | 67.00 | Little *et* al., 1967 |
| *Limnocharis flava* | 14.22 | 9.20 | 7.60 | 7.63 | 72.84 | Present study |

All values are in percentage.

Boyd (1969) found that the crude protein levels in *Pistia stratiotes* and *Hydrilla verticellata* was 0.78% and 1.37% respectively. The crude Protein content of *Limnocharis flava* is appreciably higher than that most of the other common aquatic weeds of Kerala. The Crude fibre content of *Limnocharis flava* was comparable to the studies by Alfrod, 1952 and Linn, 1975a on Alteranthera philoxeroides and Chara vulgaris. The mean crude protein levels were as high as values reported for many high quality forages (Morrison, 1961). On comparing the chemical composition of *Limnocharis flava* with other common tropical feedstuffs, it has been observed that the plant has rather similar or high values than the other common feeds (Table 6).



To cite this paper: Smitha Chandran S and Ramasamy EV, 2015. Utilization of *Limnocharis flava,* an invasive aquatic weed from Kuttanad wetland ecosystem, Kerala, India as a potential feedstock for livestock. *Online J. Anim. Feed Res.*, 5 (1): 22-27.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

**Table 5** - The Chemical Composition (% of dry matter) in some common tropical feeds.

| Items | DM | CP | Ash | Crude fibre | References |
|---|---|---|---|---|---|
| Chopped whole Sugarcane | 23.7 | 2.5 | 2.3 | 41.1 | Van et al., 2001 |
| Rice straw | 89.4 | 3.88 | 4.9 | — | Keir et al., 1997 |
| *Fleminga macrophylla* | 28.5 | 18.3 | 5.4 | 52 | Van et al., 2005 |
| Jackfruit foliages | 32.8 | 14.8 | 10.6 | 50.6 | Van et al., 2001 |
| *Acacia mangium* | 31.6 | 16.2 | 4.6 | 49.8 | Van et al., 2004 |
| Cassava hay | 28.5 | 15.6 | 9.8 | — | Keir et al., 1997 |
| Rubber seed cake | 12.5 | 14.8 | 5.9 | 34.7 | Hao and Ledin, 1999 |
| Ground nut cake | 88.1 | 3.02 | 1.3 | 26.2 | Hao and Ledin, 1999 |
| *Limnocharis flava* | 9.0 | 9.68 | 9.68 | 7.94 | Present study |

**Table 6** - Recommended Mineral requirements for lactating cattle

| Mineral Constituent | Percent in dry matter* | Present study |
|---|---|---|
| Calcium | 0.43-0.77% | 5.76% |
| Phosphorous | 0.28-0.49% | 0.79% |
| Potassium | 0.90-1.00% | 1.29% |
| Sodium | 0.18% | 0.035% |
| Iron | 50ppm | 2.23ppm |
| Copper | 0.10ppm | 0.025ppm |
| Manganese | 40ppm | 0.08ppm |
| Zinc | 40-60ppm | 0.007ppm |

* As recommended in Sharma and Mahajan, 2002.

The calcium, phosphorous and potassium content during its mature stage is 5.6%, 0.76% and 1.19% respectively are equal to or above the nutritional requirement for finishing cattle (National Academy of Sciences, 1976). On comparing the mineral requirements of lactating dairy cattle (Table 5) with that of the present study it has been observed that the calcium, phosphorous and potassium concentrations are exceeding the prescribed values for lactating cattle. Moreover, compared to other alien aquatic weeds like *Eichhornia crassipes, Alternanthera philoxeroides, Pistia stratiotes, Hydrilla verticellata, Chara vulgaris, Typha aungustifolia* and *Potamageton pectinatum* this emergent aquatic weed has higher value of Crude protein, Ash and Crude fibre.

## CONCLUSION

In this study, the possibility of utilizing this plant as a food was considered. Based on the proximate and chemical analysis done, the plant species appears to be a potential feed for domestic livestock. These species produce mono specific stands, which cover large areas. Therefore, methods of utilization would develop an important resource in many areas.

Analyses of the dehydrated samples indicate that the plant contain rather large amounts of crude protein, crude fibre and ether extract and had satisfactory level of micro-minerals like Iron, Copper, Manganese and Zinc. More over the concentrations of macro-minerals like Calcium, Potassium and Phosphorous is very high and rather higher than the requirements for lactating cattle.

In summary, *Limnocharis flava* seem to possess several characteristics, which make it as a suitable candidate for consideration as a cattle feed. The utilization of this weed as a source of livestock feed also serves as an effective means of weed control.

## REFERENCES


Abbasi SA and Nipaney PC (1986). Infestation of fern genus Salvinia: Its status and control. *Environmental Conservation.* 13: 235-241.

Abbasi SA and Ramasamy EV (1999). Biotechnological Methods of Pollution Control, Orient Longmann (Universities Press of India Ltd. Hyderabad), India. pp. 168.

Alfrod L.W (1952). Alligator weed–a good cattle food, *Chemurg. Dig*, 2(9): 10-12

AOAC (1990). Association of Official Analytical Chemists. Official Methods of Analysis. 15th Edition Washington D.C. pp 69-88.

Bahadur KN and Raizada M B (1968). *Limnocharis flava* (L.) Buchenau- a new record for India. *Indian forester.* 94: 641-644.

Bailey TA (1965). Commercial possibilities of dehydrated plants. *Proceedings of Annual Meet South Weed Science Society.* 18: 543-551.

Bindu T and Ramasamy EV (2005). High solids anaerobic digestion for the recovery of energy and manure from Taro (*Colocasia esculenta*). *Journal of Solid Waste Technology and Management*. 31(2): 69-77.

Boyd CE (1968). Fresh water plants: a potential source of protein. *Economic Botany.* 22: 359-368.

Boyd CE (1968a). Evaluation of some common aquatic weeds as possible feed stuffs. *Hyacinth Control Journal.* 7:26-27.

Boyd CE (1969). Nutritive value of three species of water weeds. *Economic Botany*. 23:123-127.

Gajalakshmi S. Ramasamy EV and Abbasi SA (2001). Potential of two epigcic and two anesic earthworm species in vermicomposting of water hyacinth. *Bioresource Technology.* 76: 177-181.

Gupta OP (1979). Aquatic weeds: Their menace and control. *Today and Tomorrows publishers.* New Delhi. Pp. 172-175.

Hao NV and Ledin I (1999). The potential of *Gliricidia matulata* leaves as a livestock feed in small holder farming systems in Vietnam, M.Sc. thesis in the programme "Tropical Livestock Systems". SLU. Department of Animal Nutrition and Management. P.O. Box 7024. Uppsala. Sweden.

Harper HJ and HA Daniel (1935). Chemical Composition of certain aquatic plants. *Bot Gaz.,* 96: 186-189.

Holm Neilson B and Haynes R (1992). Flora Neotropica: Monograph (56) on Limnocharitaceae. Royal Botanic gardens. Kew, United Kingdom.

Kammathy RV and Subramanyan K (1967). *Limnocharis flava* H.B.K A genus new to India *Journal of Bombay Natural History Society.* 64:389-390.

Keir B Binh DV, TR Orskov E (1997). Nutritive value of leaves from tropical trees and shrubs (1 and 2) Livestock Research for Rural Development: 9 (4).

Kurian J and Ramasamy EV (2005). Vermicomposting of Taro *(Colocasia esculenta)* with two epigeic earthworm species. *Bioresources Technology.* 97: 1324-1328.

Linn JG (1957). Nutritive value of dried or ensiled aquatic plants.1. Chemical Composition. *Journal of Animal Science.* 41(1):601-609.

Linn JG (1975a). Nutritive value of dried or ensiled aquatic plants to digestibility to sheep, *Journal of Animal Science* 41(1): 610-615.

Little ECS and IE Henson (1967). The water content of some important tropical water weeds. *PANS(C*). 13(3): 223-227.

Morrison FB (1961). Feeds and feeding abridged. The Morrisom Publ. Co., Clinton, Iowa. Pp. 696.

Muktar AMS (1967). A Preliminary study on the chemical composition of water hyacinth (*Eichhornia crassipes*) in the Sudan. *Sudan Journal of Veterinary Science and Animal Husbandry* 8(2):141-147.

National Academy of Sciences. (1976). Nutrient requirements of reef cattle. Washington DC. pp 56.

Osche JJ and RC Bakhuizen Van den Brink (1931). Vegetables of Dutch East Indies. Department of Agriculture. Industry and Commerce of the Netherlands East Indies. Buitonzory, Java.

Ramakrishnan PS (1999). Biological invasion as a component of global change: The Indian context. Proceedings of the workshops held at Kerala Forest Research Institute. Peechi. Kerala.2-4 November: pp. 28-34.

Ramasamy EV and Abbasi SA (1999). Utilization of biowaste solids by extracting volatile fattyacids with subsequent conversion to methane and manure. *Journal of Solid Waste Technology and Management*. 26 (3&4): 133 - 139.

Senaratna JE (1940). *Tropical Agriculture*. 94: 362-364.

Sharma M and Mahajan V (2002). Role of minerals supplementation in forage based rations of dairy animals. *Indian farming.* Pp. 28-31.



To cite this paper: Smitha Chandran S and Ramasamy EV, 2015. Utilization of *Limnocharis flava,* an invasive aquatic weed from Kuttanad wetland ecosystem, Kerala, India as a potential feedstock for livestock. *Online J. Anim. Feed Res.*, 5 (1): 22-27.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Van DTT and Ledin I (2001). Effect of different foliages and the sugar cane in the diet in late pregnancy on ewe and lamb performance. *Asian-Australian Journal of Animal Science*. Pp. 828-833.

Van DTT Nguyen Thi Mui and Ledin (2004). Effect of adding Bamboo charcoal to a diet of concentrate para grass and *Acacia mangium* on digestibility and Nitrogen balance in goats. *Animal Feed Science Technology.* 118: 1-17.

Van DTT Nguyen Thi Mui and Ledin (2005). Tropical foliages: effect of presentation method and species on intake by goats. *Animal Feed Science and Technology*. 118: 1-17.



To cite this paper: Smitha Chandran S and Ramasamy EV, 2015. Utilization of *Limnocharis flava,* an invasive aquatic weed from Kuttanad wetland ecosystem, Kerala, India as a potential feedstock for livestock. *Online J. Anim. Feed Res.*, 5 (1): 22-27.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

*Online Journal of Animal and Feed Research*

*Volume 5, Issue 1: 28-32; Jan 25, 2015* ISSN 2228-7701

# NUTRITIVE VALUE OF SAL SEED (*Shorea robusta*)

**Md. Emran HOSSAIN[1], Md. Hossain KABIR[2], Sabuj Manohar SARMA[2] and Hillol SIKDER[2]**

*[1]Department of Animal Science and Nutrition, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*
*[2]UG student, Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University Khulshi, Chittagong-4225, Bangladesh*
*Email: emrancvasu@yahoo.com

**ABSTRACT***:* The study was undertaken to find out the chemical composition and nutritive value of Sal seed (*Shorea robusta*) available in Bangladesh. *Shorea robusta* seeds were collected from different remote places of study areas. Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash (TA) in the animal nutrition and poultry research and training centre (PRTC) laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Results indicated that, air dried corticated *Shorea robusta* seed contained 91.6% DM, 7.7% CP, 17.8% CF, 8.1% EE, 54.3% NFE and 3.7% TA. Similarly, air dried decorticated seed contained 88.7% DM, 8.8% CP, 7.3% CF, 10.0% EE, 58.6% NFE and 4.0% TA. Air dried seed shell contained 88.5% DM, 5.8% CP, 39.3% CF, 3.7% EE, 34.8% NFE and 4.9% TA. Metabolizable energy (ME) was 2614.2 Kcal/kg, 2933.0 Kcal/kg and 1582.9 Kcal/kg in corticated seed, decorticated seed and seed shell respectively. It could therefore be inferred that, the *Shorea robusta* seed seems nutritionally sound enough to be utilized as unconventional feed for ruminant especially during scarcity period.

**Keywords:** Chemical Composition, Nutritive Value, Metabolizable Energy, *Shorea robusta*.

ORIGINAL ARTICLE
pii: S222877011500005-5
Received 05 Jan. 2015
Accepted 20 Jan. 2015

## INTRODUCTION

Sal is a dominant tall tree providing excellent quality timber. Its botanical name is *Shorea robusta*. Local name in Bengali is Sal. It grows well in deciduous dry and evergreen moist forests with sandy loam soil of low height plain land from 200 to 1200 meters above sea level and sensitive to frost and water logging condition (Orwa et al., 2009). It grows extensively in Northern and Central India and as far north as the outer Himalayan region. This is a native tree to Myanmar and Nepal. It is moderate to slow growing and attain heights of 30 to 35 m with a trunk diameter of up to 2-2.5 m in around 100 years under favorable conditions. The leaves are simple, shiny, reddish and glabrous about 10-25 cm long and 5-15 cm broad (Orwa et al., 2009).

Sal seed leaves are used as medium to poor quality roughage (Orwa et al., 2009). The high content of NFE suggests using it as a source of cheap metabolizable energy (ME) in livestock diets in place of cereals like maize and barley. Sal seed fat has a buttery texture with a fatty acid composition of palmitic acid (4.5%), stearic acid (44.2%), arachidic acid (6.3%), oleic acid (42.2%) and lenoleic acid (2.8%). The oil is used for cooking and lighting and is suitable as a substitute for cocoa butter in the manufacture of chocolate (CSIR, 1972). On a dry matter basis, Sal seed meal has a low content of calcium (0.18-0.29%) and phosphorus (0.16-0.18) (ICAR, 1967). The tannin content appears to be 3.5 to 4.0% (Panda, et al., 1969), 6.2 to 13.7% (Devendra, 1988) and 7.6% (Kumar et al., 1970). Verma (1970) determined ME value of 11.10MJ/kg in goats (Khan et al., 1986). Negi (1982) reviewed the use of Indian Sal seed in livestock rations and concluded that it is comparable to other poor quality roughages.



To cite this paper: Hossain M.E., Kabir M.H., Sarma S.M. and Sikder H. 2015. Nutritive value of Sal seed (Shorea Robusta). *Online J. Anim. Feed Res.*, 5(1): 28-32.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

No systematic study has so far been conducted to find out the chemical composition of Sal seed available in Bangladesh. Therefore, current study aimed to collect process and determine the chemical composition and nutritive value of Bangladeshi Sal seed.

## MATERIAL AND METHODS

### Study area

Most of the Sal forests in Bangladesh are extended over Madhupur and very few of them in Chittagong, Rangpur, Dinajpur and Rajshahi districts. However, most of the Sal forests are degrading and encroached by industrial plantation of fuel woods along with exotic species. The Chittagong Sal forest is the largest Sal forest patch in the country. Therefore, the current study was conducted in Chittagong Sal forest.

### Collection of sample

Sal fruits start falling on ground from 2nd to 3rd week of May. Strong wind and storm help in bumper fall of Sal seed towards end of May. Collection seed was done in forenoon because of apprehension for casual storm and rainfall in the afternoon. Fresh seeds were collected from Chittagong area under standard random sampling technique. Total 3.0 kg of seeds were collected directly from the Sal forest for a total period of 30 days. Production of kernel from seed was almost 2:1. Seeds were packed in airtight sacks and sent to the Animal Nutrition and PRTC laboratory, Chittagong Veterinary and Animal Sciences University for proximate analysis.

### Preparation of sample

From the winged fruit, Sal seed was processed in two gradual stages. De-winging was done in two different ways. The fruit after being completely dried were beaten on plain hard ground with a wooden stick to break the brittle wings. In this process the wings were broken and round seed pods with shell and covers were separated.

### Chemical Analysis

Chemical analyses of the samples were carried out in triplicate dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash (TA) in the Animal Nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong as per AOAC (2006).

### Estimation of ME

All samples were subjected to proximate analysis in triplicate. Later on, ME available in all seeds, kernel and shells were estimated by using a standard mathematical formula as per Lodhi et al. (1976).

### Data analysis

Data related to chemical composition and nutritive value of corticated *Shorea robusta* seed, decorticated *Shorea robusta* seed and *Shorea robusta seed* shell were collected, compiled and analyzed for mean values by using Microsoft Excel 2007.

## RESULTS AND DISCUSSION

The average DM contents of corticated *Shorea robusta* seed, decorticated seed (Inner kernel) and seed shell estimated in this study were 91.6%, 88.7% and 88.5% respectively. The average CP contents of corticated seed, decorticated seed and seed shell were 7.7%, 8.7% and 5.8% respectively. The average CF contents of corticated seed, decorticated seed and seed shell were 17.8%, 7.3% and 39.3% respectively. The average NFE contents of corticated seed, decorticated seed and seed shell were 54.3%, 58.6% and 34.8% respectively. The average EE contents of corticated seed, decorticated seed and seed shell were 8.1%, 10.0% and 3.7% respectively. The average TA contents of corticated seed, decorticated seed and seed shell were 3.7%, 4.0% and 4.9% respectively. The average ME contents of corticated seed, decorticated seed and seed shell were 82614.2%, 2933.0% and 1582.9% respectively.

*Shorea robusta* seed has been used successfully in a wide range of studies. In cattle, up to 20% has been recommended (Gohl, 1982). Up to 30% was recommended in diets for growing heifers with or without 2% urea (Sonwane et al., 1974; Devendra, 1985). In growing calves, supplementation of 30% seed meal did not affect health, intake and performance (Garg et al., 1984). Recommendations have been made for its incorporation in poultry mashes at 5-7% level. In concentrate mixtures for growing and lactating cattle 10-20% was suggested (ICAR, 1972). In another study, deoiled seed meal replaced maize in dairy cows up to 20% (Rajagopal et al., 1983). Kurar and Mudgal (1972) included 10, 20 and 30% seed meal and 2% biuret in diets for growing heifers and found


To cite this paper: Hossain M.E., Kabir M.H., Sarma S.M. and Sikder H. 2015. Nutritive value of Sal seed (Shorea Robusta). *Online J. Anim. Feed Res*., 5(1): 28-32.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

that up to 30% of the meal and 2% biuret was optimum for growing heifers. The seed cake has a low protein and fat content and its usefulness as feedstuff has been questioned (Negi, 1982). Despite many advantages, inclusion of 40% seed in cattle diet caused indigestion (Dash et al., 1972) and bullocks receiving 100% meal lost 14.0 kg in 60 days (Shukla and Talapada, 1973). In another study, digestibility of the seed meal was negative (Robb, 1976). It was suggested that tannins may have formed complexes with proteins in the meal to give the negative result.

**Table 1 - Chemical composition (% Air DM) and nutritive value of corticated *Shorea robusta* seed**

| Parameter | Unit (% Air DM) |
|---|---|
| Dry matter (DM) | 91.6 |
| Crude protein (CP) | 7.7 |
| Crude fiber (CF) | 17.8 |
| Nitrogen free Extract (NFE) | 54.3 |
| Ether Extract (EE) | 8.1 |
| Ash | 3.7 |
| Metabolizable Energy (Kcal/kg) | 2614.2 |

**Table 2- Chemical composition (% Air DM) and nutritive value of decorticated (Inner kernel) *Shorea robusta* seed**

| Parameter | Unit (% Air DM) |
|---|---|
| Dry matter (DM) | 88.7 |
| Crude protein (CP) | 8.8 |
| Crude fiber (CF) | 7.3 |
| Nitrogen free Extract (NFE) | 58.6 |
| Ether Extract (EE) | 10.0 |
| Ash | 4.0 |
| Metabolizable Energy (Kcal/kg) | 2933.0 |

**Table 3 - Chemical composition (% Air DM) and nutritive value of *Shorea robusta* seed shell**

| Parameter | Unit (% Air DM) |
|---|---|
| Dry matter (DM) | 88.5 |
| Crude protein (CP) | 5.8 |
| Crude fiber (CF) | 39.3 |
| Nitrogen free Extract (NFE) | 34.8 |
| Ether Extract (EE) | 3.7 |
| Ash | 4.9 |
| Metabolizable Energy (Kcal/kg) | 1582.9 |

Tannins adversely affect the utilization of other feed proteins while attempts to remove tannins from seed meal are neither effective nor practicable (Negi, 1982). Tannins in the diet resulted in reduced weight gain and poor feed efficiencies in chicken (Ahmed et al., 1991; Santos-Buelga and Scalbertm, 2000). By virtue of its availability, the seed and seed meal have a tremendous potential for its utilization as animal feed. However, the utilization of seed and seed meal as feed for cattle, poultry, and pigs showed that tannins limited their utilization (Negi, 1982, 1990). Nutritive value of 3% untreated seed meal and 0.1% NaOH treated seed meal was compared by lactating Murrah buffaloes. It was evident that, digestibility of crude protein and production of milk were favored by alkali treatment (Singh and Arora, 1981). In another study, Rao and Rao (1986) also reported 20-71% losses in dry matter of *Shorea robusta* seed meal as a result of washing after soaking in sodium hydroxide and sodium carbonate, respectively.

*Shorea robusta* seed cake has negative effects in poultry due to high tannin content. Inclusion of 50 g seed meal/kg in the diet of chicks resulted retarded growth and poor feed efficiency (Zombade et al., 1979). Similarly, broilers and layers fed 50% seed cake showed depressed nutrient digestibility and lower pancreatic and intestinal enzyme activity and hens produced eggs with discolored, greenish-yellow eggs (Mahmood et al., 2006). In another study, Panda et al., (1975) replaced maize by *Shorea robusta* seed meal in chick diets at levels varying between 2.25 to 45% and found an inverse relationship between seed meal level and body weight attained by the chicks. Similarly, Mohanty et al. (1967) substituted 2.4 to 5.0% of the maize with *Shorea robusta* seed meal to feed chicks up to eight weeks of age. The results indicated depression in growth rate compared to the control diets.


To cite this paper: Hossain M.E., Kabir M.H., Sarma S.M. and Sikder H. 2015. Nutritive value of Sal seed (Shorea Robusta). *Online J. Anim. Feed Res.*, 5(1): 28-32.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Up to 40% *Shorea robusta* seed cake in pig diets replacing maize had no significant effect on pig performance (Pathak et al., 1973; Devendra, 1985). Murty et al. (1969) used 20% seed meal to replace maize and noted reduced live weight gain, N and P balance. Similarly, Agarwal (1971) reported a drastic drop in live weight gain when maize or Ragi was replaced by deoiled *Shorea robusta* seed meal.

## CONCLUSION

*Shorea robusta* seed is good source of crude protein. However, it contains tannins that can be removed either by boiling or soaking in water. Therefore, tannin in *Shorea robusta* seed is no more a problem. Additionally, tannin present in seed has protein binding capacity. Therefore, *Shorea robusta* seed cake may be used to improve forages containing highly degradable protein. Apart from seed, *Shorea robusta* leaves may also be used for feeding the silkworm pupa (*Antheraea mylitta*) for garments industry.

## REFERENCES


Agarwal DK (1971). Effect of plane of nutrition on performance and carcass characteristics of large white Yorkshire pigs. Ph.D. Thesis, Agra University, Agra, India.

Ahmed AE, Smithard R and Ellis M (1991). Activities of enzymes of the pancreas, and the lumen and mucosa of the small intestine in growing broiler cockerels fed on tannin-containing diets. British Journal of Nutrition, 65: 189-197.

AOAC (2006). Official Methods of Analysis of AOAC International. Association of Official Analytical Chemists. 18th edition (Editor: William Horwitz, George W. Latimer), Gaithersburg, USA.

Appanah S and Turnbull JM (1998). Review of dipterocarps: taxonomy, ecology, and silviculture. CIFOR, Bogor, Indonesia.

CSIR (1972). The Wealth of India, Raw Materials. Dictionary of Indian Raw Materials and Industrial Products. Publication and Information Directorate, Council of Scientic and Industrial Research, New Delhi, India.

Dash PK and Misra SK (1972). Effect of sudden change of feed from normal to Sal seed supplemented ration on the ruminal activities of dairy cows and the results of stomach therapy on these animals. Indian Veterinary Journal, 49 (10): 1035-1040.

Devendra C (1985). Non conventional feed resources in Asia and the Pacific. FAO Regional Office for Asia and the Pacific, 2nd edn., Bangkok.

Evers AD, O'Brien L and Blakeney AB (1999). Cereal structure and composition. Australian Journal of Agriculture Reseach, 50: 629-650.

Garg AK, Agrawal DK and Nath K (1984). Effect of Sal (*Shorea robusta*) seed meal tannins on serum enzymes, nutrient utilization and growth in growing calves. Agricultural Wastes, 11(4): 307-317.

Gohl B (1982). Les aliments du bétail sous les tropiques. FAO, Division de Production et Santé Animale, Roma, Italy.

ICAR (1967). Report of the study group for exploring the possibility of using food byproducts as poultry feed. Indian Council of Agriculture Research, New Delhi.

Jolly MS, Sen SK and Das MG (1976). Silk from the forest. In: Unasylva 28 (4), No. 114- Employment.

Khan MY, Lal M and Krishan J (1986). Nutritional evaluation of deoiled oilseed (*Shorea robusta*) meal of goats, Indian Journal of Animal Nutrition, 3: 29-32.

Kumar GV, Subha Rao A, Sampath SH and Mudgal VD (1970). Report of studies on Sal seed meal; Workshop in Agricultural By-pro ucts and Waste Materials for economic rations for livestock, U.P.A.U., Pantnagar 21st to 23rd October, 1970.

Kurar CK and Mudgel VD (1972). Effect of feeding Sal seed meal in the utilization of feeds containing non-protein nitrogen compound in growing heifers. Indian Journal of Animal Science, 42: 393-398.

Lodhi GN, Daulat Singh and Ichhponani JS (1976). Variation in nutrient content of feeding stuffs rich in protein and reassessment of the chemical method for metabolizable energy estimation for poultry. Journal of Agricultural Science, 86(2): 293-303.

Murty VN, Joshi BC and Agarwal DK (1969). Evaluation of Sal seed meal in the ration of pigs. Scientific Annual Reports, Division of Animal Nutrition, IVRI, India.

Nagpaul PK, Verman PN and Chawla MS (1973). Some observation on the feeding of Sal seed meal (*Shorea robusta*) to the animals. Indian Veterinary Journal, 50: 352-356.

Nayak NC, Tripathi SB and Moh-anty K (1967). Use of decorticated Sal seed asa poultry feed - A preliminary trial. Indian Veterinary Journal, 40: 706.

Negi SS (1982). Tannins in Sal seed (*Shorea robusta*) and Sal seed meal limit their utilization as livestock

feeds. Animal Feed Science and Technol., 7: 161-183.

Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S (2009). Agroforestree Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, Kenya.

Panda NC, Mitro A, Kedary S and Parichha SN (1975). Sal seed and Sal oil meal as cereal substitute in starter mash. Indian Veterinary Journal, 52: 186-189.

Panda V (1970). Processings and utilization of agro-industrial by-products as livestock and poultry feed. Indian Poultry Gazettee, 54: 39.

Panda V, Jayaraman M, Ramamurty NS and Nair RS (1969). Processing and Utilization of Sal seed (*Shorea robusta*) as a source of energy in poultry feed. Indian Veterinary Journal, 46: 1075-1079.

Panda NC and Pradhan SC (1967). Chemical composition of Sal (*Shorea robusta*) fruits. Indian Veterinary Journal, 44: 62-64.

Pathak NN and Ranjhan SK (1973). Nutritional studies with Sal seed meal as a component of finisher rations in the large white Yorkshire pigs. Indian Journal of Animal Science, 43: 424-427.

Rajagopal S, Murty VN (1983). Deoiled Sal seed meal (DSSM) as an energy source in place of maize in the ratios of lactating crossbred cows. Agricultural Wastes, 5 (2): 83-94.

Rao VS and Rao KM (1986). Detaining of deoiled Sal seed (*Shorea robusta*) meal with sodium carbonate followed by washing of water. Indian Forester, 112: 253-260.

Robb J (1976). Alternatives to conventional cereals. In Feed Energy Sources for Livestock, Butterworth, London, pp. 13-28.

Santos-Buelga C and Scalbert A (2000). Proanthocyanidins and tanin-like compounds nature, occurrence, dietary intake and effects on nutrition and health. Journal of the Science of Food and Agriculture, 80: 1094-1117.

Shalini Trivedi, Mahanta SK, Kundu SS (2007). Evaluation of protein rich feed resources with different levels of tannin for their in vitro utilization. Range Management and Agroforesty, 28 (2B): 233-235.

Shukla PC and Talapada PM (1973). Studies on feeding Sal seed meal to adult animais. Indian Veterinary Journal, 50: 669-672.

Singh K and Arora SP (1981). Note on the influence of tannin of Sal seed meal on feed utilization and milk production in lactating buffaloes. Indian Journal of Animal Science, 5: 1078-1081.

Sonwane SN, Mudgal VD (1974). The utilization of Sal seed (*Shorea robusta*) meal as a feed supplement in the ration of growing heifers. Indian Journal of Dairy Science, 27: 183-187.

Tripathi AK (1975). Effect of Sal seed tannin and tannic acid on protein degradation in goats rumen (in vitro). Indian Veterinary Journal, 52: 195-200.

Verma SVS (1970). Studies on the metabolizable energy value of Sal seed (*Shorea robusta*) and Sal seed cake by chemical assay anU-biological evolution in chicks. M.V.Sc. Thesis, Agra University, India.

Zombade SS, Lodhi GN, Ichhponani JS (1979). The nutritional value of Sal seed (*Shorea robusta*) meal for growing chicks. British Poultry Science, 20 (5): 433-438.



To cite this paper: Hossain M.E., Kabir M.H., Sarma S.M. and Sikder H. 2015. Nutritive value of Sal seed (Shorea Robusta). *Online J. Anim. Feed Res*., 5(1): 28-32.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

# Instructions for Authors

OJAFR EndNote Style  Manuscript Template  Sample Articles  Declaration form

Manuscript as Original Research Paper, Short Communication, Case Reports and Review or Mini-Review are invited for rapid peer-review publishing in the *Online Journal of Animal and Feed Research (ISSN 2228-7701)*.

Papers can be in any relevant fields of Animal Sciences (Animal Nutrition, Physiology, Reproduction, Genetics and Breeding, Behavior, Health, Husbandry and its economic, Animal products and Veterinary medicines of domestic animals) and relative topics. The journal does encourage papers with emphasis on the nutritive value and utilization of feeds that is depended to methods of Improvement, Assessment, Conserving and Processing feeds, Agronomic and climatic factors, Metabolic, Production, Reproduction and Health responses to dietary inputs (e.g., Feeds, Feed Additives, Specific Feed Components, Mycotoxins). Also, Mathematical models relating directly to animal-feed interactions, Analytical and experimental methods for Feed Evaluation as well as Animal Production studies with a focus on Animal Nutrition that do have link to a feed (Food Science and Technology) are acceptable relative topics for OJAFR**.**

## Submission

The manuscript should preferentially be submit online. For facile submission, please embed all figures and tables at the end of the manuscript to become one single file for submission. Once submission is complete, the system will generate a manuscript ID and password sent to author's contact email. If you have any difficulty in submitting the manuscript, kindly send via email: editors@ojafr.ir. All manuscripts must be checked (by English native speaker) and submitted in English for evaluation in totally confidential and impartial way.

### Supplementary information:

Author guidelines are specific for each journal. Our MS Word template can assist you by modifying your page layout, text formatting, headings, title page, image placement, and citations/references such that they agree with the guidelines of journal. If you believe your article is fully edited per journal style, please use our Word template before submission.
Supplementary materials may include figures, tables, methods, videos, and other materials. They are available online linked to the original published article. Supplementary tables and figures should be labeled with a "S", e.g. "Table S1" and "Figure S1". The maximum file size for supplementary materials is 10MB each. Please keep the files as small as possible to avoid the frustrations experienced by readers with downloading large files.

### Submission to the Journal is on the understanding that:

1.The article has not been previously published in any other form and is not under consideration for publication elsewhere;
2.All authors have approved the submission and have obtained permission for publish work.
3.Researchers have proper regard for conservation and animal welfare considerations. Attention is drawn to the *'Guidelines for the Treatment of Animals in Research and Teaching'*. Any possible adverse consequences of the work for populations or individual organisms must be weighed against the possible gains in knowledge and its practical applications. If the approval of an ethics committee is required, please provide the name of the committee and the approval number obtained.

### Ethics Committee Approval

Experimental research involving human or animals should have been approved by author's institutional review board or ethics committee. This information can be mentioned in the manuscript including the name of the board/committee that gave the approval. Investigations involving humans will have been performed in accordance with the principles of *Declaration of Helsinki*.
And the use of animals in experiments will have observed the *Interdisciplinary Principles and Guidelines for the Use of Animals in Research, Testing, and Education* by the New York Academy of Sciences, Ad Hoc Animal Research Committee.
If the manuscript contains photos or parts of photos of patients, informed consent from each patient should be obtained. Patient's identities and privacy should be carefully protected in the manuscript.

## Presentation of the article

### Main Format:

First page of the manuscripts must be properly identified by the title and the name(s) of the author(s). It should be typed in Times New Roman (font sizes: 12pt in capitalization for the title and the main text, double spaced, in A4 format with 2cm margins. All pages and lines of the main text should be numbered consecutively throughout the manuscript. The manuscript must be saved in a .doc format, (not .docx files). Abbreviations in the article title are not allowed except the well-known ones.

**Manuscripts should be arranged in the following order:**

a. TITLE (brief, attractive and targeted);

b. Name(s) and Affiliation(s) of author(s) (including post code) and corresponding E-mail;

c. ABSTRACT;

d. Key words (separate by semicolons; or comma,);

e. Abbreviations (used in the manuscript);

f. INTRODUCTION;

g. MATERIALS AND METHODS;

h. RESULTS;

i. DISCUSSION;

j. CONCLUSION;

k. Acknowledgements (if there are any);

1. REFERENCES;

m. Tables;

n. Figure captions;

o. Figures;

The sections "RESULTS AND DISCUSSION" can be presented jointly.

The sections "DISCUSSION AND DISCUSSION" can be presented jointly.

## Article Sections Format:

**Title** should be a brief phrase describing the contents of the paper. Title Page should include the author(s)'s full names and affiliations, the name of the corresponding author along with phone and e-mail information. Present address(es) of author(s) should appear as a footnote.

**Abstract** should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The abstract should be 150 to 300 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 7 **key words** should be listed.

**Introduction** should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

**Materials and Methods** should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.

**Results** should be presented with clarity and precision. The results should be written in the past tense when describing findings in the author(s)'s experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the results but should be put into the discussion section.

**Discussion** should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

**Conclusion** should be brief and tight, providing a few specific tasks to accomplish: 1-Re-assert/Reinforce the Thesis; 2-Review the Main Points; 3- Close Effectively. The Conclusion section should not be similar to the Abstract content.

**Declarations** including Ethics, Consent to publish, Competing interests, Authors' contributions, and Availability of data and materials are necessary.

**Acknowledgments** of persons, grants, funds, etc should be brief.

**Tables** should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph forms or repeated in the text.

**The Figure** legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or PowerPoint before pasting in the Microsoft Word manuscript file. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

## Declarations section - Please include declarations heading

Please ensure that the sections:
-Ethics (and consent to participate)
-Consent to publish
-Competing interests
-Authors' contributions
-Availability of data and materials
are included at the end of your manuscript in a Declarations section.

### Consent to Publish

Please include a 'Consent for publication' section in your manuscript. If your manuscript contains any individual person's data in any form (including individual details, images or videos), consent to publish must be obtained from that person, or in the case of children, their parent or legal guardian. All presentations of case reports must have consent to publish. You can use your institutional consent form or our consent form if you prefer. You should not send the form to us on submission, but we may request to see a copy at any stage (including after publication). If your manuscript does not contain any individual person's data, please state "Not applicable" in this section.

### Authors' Contributions

For manuscripts with more than one author, OJAFR require an Authors' Contributions section to be placed after the Competing Interests section. An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. To qualify as an author one should 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; and 3) have given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.
We suggest the following format (please use initials to refer to each author's contribution): AB carried out the molecular genetic studies, participated in the sequence alignment and drafted the manuscript. JY carried out the immunoassays. MT participated in the sequence alignment. ES participated in the design of the study and performed the statistical analysis. FG conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.
For authors that equally participated in a study please write '**All/Both authors contributed equally to this work**.' Contributors who do not meet the criteria for authorship should be listed in an acknowledgements section.

### Competing Interests

Competing interests that might interfere with the objective presentation of the research findings contained in the manuscript should be declared in a paragraph heading "Competing interests" (after Acknowledgment section and before References). Examples of competing interests are ownership of stock in a company, commercial grants, board membership, etc. If there is no competing interest, please use the statement "The authors declare that they have no competing interests.".
*Online Journal of Animal and Feed Research* adheres to the definition of authorship set up by the International Committee of Medical Journal Editors (ICMJE). According to the ICMJE authorship criteria should be based on 1) substantial contributions to conception and design of, or acquisition of data or analysis and interpretation of data, 2) drafting the article or revising it critically for important intellectual content and 3) final approval of the version to be published. Authors should meet conditions 1, 2 and 3. It is a requirement that all authors have been accredited as appropriate upon submission of the manuscript. Contributors who do not qualify as authors should be mentioned under Acknowledgements.

### Change in authorship

We do not allow any change in authorship after provisional acceptance. We cannot allow any addition, deletion or change in sequence of author name. We have this policy to prevent the fraud.

### Acknowledgements

We strongly encourage you to include an Acknowledgements section between the Authors' contributions section and Reference list. Please acknowledge anyone who contributed towards the study by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include their source(s) of funding. Please also acknowledge anyone who contributed materials essential for the study.
Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements. Please list the source(s) of funding for the study, for each author, and for the manuscript preparation in the acknowledgements section. Authors must describe the role of the funding body, if any, in study design; in the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication.

### Data Deposition

Nucleic acid sequences, protein sequences, and atomic coordinates should be deposited in an appropriate database in time for the accession number to be included in the published article. In computational studies where the sequence information is unacceptable for inclusion in databases because of lack of experimental validation, the sequences must be published as an additional file with the article.

## References

An OJAFR reference style for **EndNote** may be found **here**.

1. All references to publications made in the text should be presented in a list with their full bibliographical description.

2. In the text, a reference identified by means of an author‘s name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author‘s surename should be mentioned, followed by ’et al‘. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like ’a‘ and ’b‘ after the date to distinguish the works.
3. References in the text should be arranged chronologically (e.g. Kelebeni, 1983; Usman and Smith, 1992 and Agindotan et al., 2003). 'et al.' should not be italic. The list of references should be arranged alphabetically on author's surnames, and chronologically per author. If an author's name in the list is also mentioned with co-authors, the following order should be used: Publications of the single author, arranged according to publication dates - publications of the same author with one co-author - publications of the author with more than one co-author. Publications by the same author(s) in the same year should be listed as 1992a, l992b,etc.
4. Names of authors and title of journals, published in non-latin alphabets should be transliterated in English.
5. A sample of standard reference is "1th Author surname A, 2th Author surname B and 3th Author surname C (2013). Article title should be regular, in sentence case form, and 9 pt. Online Journal of Animal and Feed Research, Volume No. (Issue No.): 00-00." (Journal titles should be full and not italic.)
6. If available please add DOI numbers or the link of articles at the end of each reference.

**Examples (at the text):**
Abayomi (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; Chukwura, 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001).

**Examples (at References section):**
a) For journal:
Lucy MC (2000). Regulation of ovarian follicular growth by somatotropin and insulin- like growth factors in cattle. Journal of Dairy Science, 83: 1635-1647.
Kareem SK (2001). Response of albino rats to dietary level of mango cake. J. Agric. Res.Dev. pp 31-38.
Chikere CB, Omoni VT and Chikere BO (2008). Distribution of potential nosocomial pathogens in a hospital environment. African Journal of Biotechnology. 7: 3535-3539.

b) For symposia reports and abstracts:
Cruz EM, Almatar S, Aludul EK and Al-Yaqout A (2000). Preliminary Studies on the Performance and Feeding Behaviour of Silver Pomfret (Pampus argentens euphrasen) Fingerlings fed with Commercial Feed and Reared in Fibreglass Tanks. Asian Fisheries Society Manila, Philippine 13: 191-199.

c) For edited symposia, special issues, etc., published in a journal:
Korevaar, H., 1992. The nitrogen balance on intensive Dutch dairy farms: a review. In: A. A. Jongebreur et al. (Editors), Effects of Cattle and Pig Production Systems on the Environment: Livestock Production Science. 31: 17-27.

d) For books:
AOAC (1990). Association of Official Analytical Chemists. Official Methods of Analysis, 15th Edition. Washington D.C. pp. 69-88.
Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

e) Books, containing sections written by different authors:
Kunev, M., 1979. Pig Fattening. In: A. Alexiev (Editor), Farm Animal Feeding. Vol. III. Feeding of Different Animal Species, Zemizdat, Sofia, p. 233-243 (Bg).
In referring to a personal communication the two words are followed by the year, e.g. (Brown, J. M., personal communication, 1982). In this case initials are given in the text. Where available, URLs for the references have been provided.

**Formulae, numbers and symbols**

1. Typewritten formulae are preferred. Subscripts and superscripts are important. Check disparities between zero (0) and the letter 0, and between one (1) and the letter I.
2. Describe all symbols immediately after the equation in which they are first used.
3. For simple fractions, use the solidus (/), e.g. 10 /38.
4. Equations should be presented into parentheses on the right-hand side, in tandem.
5. Levels of statistical significance which can be used without further explanations are *P < 0.05, **P < 0.01, and ***P<0.001.
6. In the English articles, a decimal point should be used instead of a decimal comma.
7. Use Symbol fonts for "±"; "≤" and "≥" (avoid underline).
8. In chemical formulae, valence of ions should be given, e.g. Ca2+ and CO32-, not as Ca++ or CO3.
9. Numbers up to 10 should be written in the text by words. Numbers above 1000 are recommended to be given as 10 powered x.
10. Greek letters should be explained in the margins with their names as follows: Aα - alpha, Bβ - beta, Γγ - gamma, Δδ - delta, Eε - epsilon, Zζ - zeta, Hη - eta, Θθ - theta, Iι - iota, Kκ - kappa, Λλ - lambda, Mμ - mu, Nν - nu, Ξξ - xi, Oο - omicron, Ππ - pi, Pρ - rho, Σσ - sigma, Tτ - tau, Yυ - ipsilon, Φφ - phi, Χχ - chi, Ψψ - psi, Ωω - omega. Please avoid using math equations in Word whenever possible, as they have to be replaced by images in xml full text.

**Abbreviations**
Abbreviations should be presented in one paragraph, in the format: "term: definition". Please separate the items by ";".
E.g. ANN: artificial neural network; CFS: closed form solution; ....

## Graphical Abstract:

Authors of accepted articles should provide a graphical abstract (a beautifully designed feature figure) to represent the paper aiming to catch the attention and interest of readers. Graphical abstract will be published online in the table of content. The graphical abstract should be colored, and kept within an area of 12 cm (width) x 6 cm (height) or with similar format. Image should have a minimum resolution of 300 dpi and line art 1200dpi.


Note: Height of the image should be no more than the width. Please avoid putting too much information into the graphical abstract as it occupies only a small space. Authors can provide the graphical abstract in the format of PDF, Word, PowerPoint, jpg, or png, after a manuscript is accepted for publication.

If you have decided to provide a Professional Graphical Abstract, please click **here**.

# Review/Decisions/Processing

Firstly, all manuscripts will be checked by Docol©c, a plagiarism finding tool. The received papers with plagiarism rate of more than 40% will be rejected. Manuscripts that are judged to be of insufficient quality or unlikely to be competitive enough for publication will be returned to the authors at the initial stage. The remaining manuscripts go through a double-blind review process by two reviewers selected by section editor (SE) or deputy SE of OJAFR, who are research workers specializing in the relevant field of study. One unfavourable review means that the paper will not be published and possible decisions are: accept as is, minor revision, major revision, or reject. The corresponding authors should submit back their revisions within 14 days in the case of minor revision, or 30 days in the case of major revision. Manuscripts with significant results are typically reviewed and published at the highest priority. The editor who received the final revisions from the corresponding authors shall not be hold responsible for any mistakes shown in the final publication.

**Plagiarism:** There is an instant policy towards plagiarism (including self-plagiarism) in our journals. Manuscripts are screened for plagiarism by Docol©c, before or during publication, and if found they will be rejected at any stage of processing.

### Date of issue

All accepted articles are published bimonthly around 25th of January, March, May, July, September and November, each year in full text on the Internet.

### Publication charges

Articles of *Online Journal of Animal and Feed Research (ISSN 2228-7701)* are freely accessible. No peer-reviewing charges are required. Publication of short reports and letter are free of charge; however, a negligible editor fee (100 USD) will be applied for long research and review papers (more than 10 pages) before copyediting and publication. Instruction for payment is sent during publication process as soon as manuscript is accepted.

# The Waiver policy

The submission fee will be waived for invited authors, authors of hot papers, and corresponding authors who are editorial board members of the *Online Journal of Animal and Feed Research*. The Journal will consider requests to waive the fee for cases of financial hardship (for high quality manuscripts and upon acceptance for publication). Requests for waiver of the submission fee must be submitted via individual cover letter by the corresponding author and cosigned by an appropriate institutional official to verify that no institutional or grant funds are available for the payment of the fee. Letters including the manuscript title and manuscript ID number should be sent to: editors@ojafr.ir. It is expected that waiver requests will be processed and authors will be notified within two business day.

### The OA policy

*Online Journal of Animal and Feed Research* is an Open Access journal which means that all content is freely available without charge to the user or his/her institution. Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author. This is in accordance with the *BOAI definition of Open Access*.

## Submission Preparation Checklist

Authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to the following guidelines:

- -The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in -Comments to the Editor).
- -The submission file is in Microsoft Word, RTF, or PDF document file format.
- -Where available, URLs for the references have been provided.
- -The text is double-spaced; uses a 12-point font; and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
- -The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines.

***

(Revised on 22 January 2015)



**Editorial Offices:**
Atatürk University, Erzurum 25100, Turkey
University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada
University of Maragheh, East Azerbaijan, Maragheh 55136, Iran
Homepage: www.science-line.com
Phone: +98 914 420 7713 (Iran); +90 538 770 8824 (Turkey); +1 204 8982464 (Canada)
Emails:
administrator@science-line.com
saeid.azar@atauni.edu.tr

# Scienceline Publishing Corporation

**Scienceline Publication**, Ltd is a limited liability non-profit non-stock corporation incorporated in Turkey, and also is registered in Iran. Scienceline journals that concurrently belong to many societies, universities and research institutes, publishes internationally peer-reviewed open access articles and believe in sharing of new scientific knowledge and vital research in the fields of life and natural sciences, animal sciences, engineering, art, linguistic, management, social and economic sciences all over the world. Scienceline journals include:

Online Journal of Animal and Feed Research


ISSN 2228-7701; Bi-monthly
View Journal I Editorial Board
Email: editors@ojafr.ir
Submit Online >>

Journal of Civil Engineering and Urbanism


ISSN 2252-0430; Bi-monthly
View Journal I Editorial Board
Email: ojceu@ojceu.ir
Submit Online >>

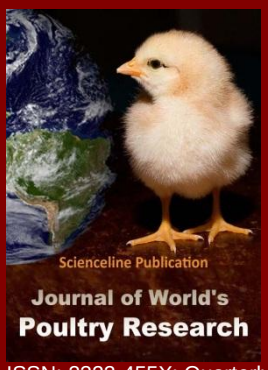
Journal of Life Sciences and Biomedicine


ISSN: 2251-9939; Bi-monthly
View Journal I Editorial Board
Email: editors@jlsb.science-line.com
Submit Online >>

Asian Journal of Medical and Pharmaceutical Researches

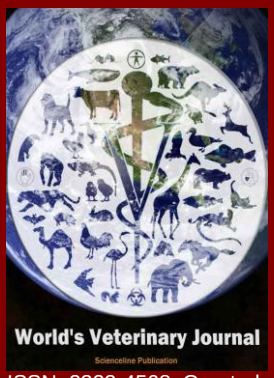

ISSN: 2322-4789; Quarterly
View Journal I Editorial Board
Email: editor@ajmpr.science-line.com
Submit Online >>

Journal of World's Poultry Research




ISSN: 2322-455X; Quarterly
View Journal I Editorial Board
Email: editor@jwpr.science-line.com
Submit Online >>

World's Veterinary Journal

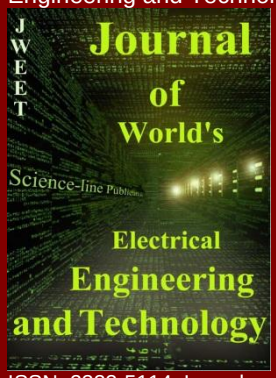



ISSN: 2322-4568; Quarterly
View Journal I Editorial Board
Email: editor@wvj.science-line.com
Submit Online >>

Journal of Educational and Management Studies

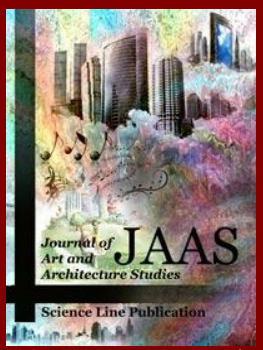

ISSN: 2322-4770; Quarterly
View Journal I Editorial Board
Email: info@jems.science-line.com
Submit Online >>

Journal of World's Electrical Engineering and Technology




ISSN: 2322-5114; Irregular
View Journal I Editorial Board
Email: editor@jweet.science-line.com
Submit Online >>

Journal of Art and Architecture Studies




ISSN: 2383-1553; Irregular
View Journal I Editorial Board
Email: jaas@science-line.com
Submit Online >>

Asian Journal of Social and Economic Sciences


ISSN: 2383-0948; Quarterly
View Journal I Editorial Board
Email: ajses@science-line.com
Submit Online >>

Journal of Applied Business and Finance Researches


ISSN: 2382-9907; Quarterly
View Journal I Editorial Board
Email: jabfr@science-line.com
Submit Online >>

Scientific Journal of Mechanical and Industrial Engineering


ISSN: 2383-0980; Quarterly
View Journal I Editorial Board
Email: sjmie@science-line.com
Submit Online >>


Scienceline Journals
Email: administrator@science-line.com