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Total Lipid, Triglyceride and Cholesterol Contents in *Oecophylla Smaragdina*, Fabricius Consumed in Upper Assam of North East India.

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Abstract- Edible insects are important dietary component that consumed as food in many developing countries. The edible insects are the rich sources of high quality proteins, fat, vitamins and minerals. Different species of edible insects contribute to variation in nutritional value which depends on the host plant, season and geographic location. The present study was aimed to assess the amount of lipid, cholesterol and triglyceride of *Oecophylla smaragdina*, Fabricius (the weaver ant) in different developmental stages, castes and in different seasons of the year collected from Upper Assam, North East India. Significant differences ($p<0.05$) were observed among all the groups and between same caste of queen and worker. The total lipid content in this particular species *Oecophylla smaragdina* of present study was from10-25% in queen larva, 10-23% in queen pupa and 10-20% in queen adult in different seasons of the year. However, the amount was found to be higher during peak period of availability. Similar trend was observed in case of worker caste but with lower magnitude which ranges from 10-13% in almost all the stages of worker caste. In case of triglyceride, amount was found maximum with 166.81 mg/gm in pupal stage of queen ant in the month of March - April and in pupal stage of worker minimum of 47.75mg/gm in the month of January. Cholesterol content was found relatively higher in pupal stage in both the caste with 15.22 mg/gm in worker pupa and 10.95 mg/gm in queen pupa. Differences in developmental stages, caste and impact of season are quite evident in the study.

Index Terms- Weaver ant, *Oecophylla*, lipid, cholesterol, triglyceride, nutrients.

I. Introduction

Edible insects are an important food resource as a part of human nutrition in many regions such as Africa, Asia and Latin America (Aletor, 1995). More than one thousand insect species are reported to be edible as traditional foods at some stages of their life cycle. Over recent decades, edible insects have been used in value-added products such as canned foods or even snacks on a commercial scale (Siriamornpun and Thammapat, 2008). Although a number of insect species are available throughout the year, some are available only for a short season depending on weather and other environmental condition. In India also large numbers of many species of edible insects are used as food. North East India with diverse ethnic groups possesses differences in culture of food intake. Insect eating is mostly prevalent amongst rural people. Rural communities of Eastern India have a long cultured history of eating insects.

Species of edible insects have been and are prominent items of commerce in the town and village markets of Africa, tropical and semi tropical regions of the world (Defoliart, 2002). In some areas of Zimbabwe, South Africa, Zambia and Nigeria, many families for their good living, do the practice of selling insects (Chavunduka, 1975; Fasoranti and Ajiboye, 1993; Mbataand Chidumayo, 2003; Adeduntan and Bada, 2004). Alamu*et al*. (2013) reported the diversity of edible insects in Nigeria, their nutritional value, host plants, collecting techniques and the processing methods. They suggested the importance in giving attention on management of this sustainable food source in the interest of food security and wealth creation. Swaminathan (1986) reported that lipid quality varies widely in plants and animal foods. Dunkel (1998) reported good fatty acid content and low cholesterol level and suggested that edible insects may be a better nutritional source to man. Adeolu (2003) demonstrated relatively higher content of phospholipid and cholesterol in insects.

In Assam, although a number of insect species is available throughout the year, some can only be obtained for a short season, dependent either on weather or other natural circumstances. The species, *Oecophylla smaragdina* Fabricius, the weaver ant (in Assamese: Amroli porua) is found available in this area only during March to May. But in other seasons though observed, it is scarce and small in size and during rainy seasons the insect species is not available. In some areas of Assam (N. E. India) the custom of eating this insect during festive season (March- April- May) is still a traditional practice but there is a dearth of information regarding the nutritional composition specially the lipid content. Their utilization, role of host plants and seasonal impact on *Oecophylla smaragdina* in this particular area.

The present study therefore attempts to determine the total lipid, cholesterol and triglyceride content of *Oecophylla smaragdina* of Assam, the North East India and to compare these values with reports on other insects and same insects from other locality and from different host plants.

II. Materials and Methods.

Different stages as adults, larvae and pupae from both queen and worker caste of the weaver ant, *Oecophylla smaragdina* were taken for experimental purpose. The ants were collected from

mango tree in different seasons of the year from Upper Assam of North East India. Total Lipid, Triglyceride and Cholesterol contents were estimated in this insect at different times of the year.

Total lipid was estimated by following the method of Frings and Dunn's Modified Method (1970) methods. Triglyceride and Cholesterol content were measured by the method of Enzymatic method of Fossenti and Principle (1982) and Allian's modified method (1974) of Richmond (1973) and Flegg's enzymatic Method respectively.

III. Statistical analysis

The results obtained were statistically analyzed by student's 't' test and $p<0.05$ was considered statistically significant.

IV. Results and Discussion

The interest in the use of insects as food item is reported by various workers (Bukkens, 1997; Finke, 2012; Victor, N. Goka and Diane Julien-David, 2012). But reports suggest different amount of lipid fractions in same insect. It is due to host plant effect and other environmental conditions. The present study which was aimed to determine the total lipid, triglyceride and cholesterol content exhibited relatively higher values in *Oecophylla smaragdina*. However, impact of seasonal variation was observed to be quite distinct in all the stages of life cycle in both queen and worker ants. Highest amount of total lipid was observed in queen larva in the month of March/ April with a mean value of 249.21 mg/ gm (Table- I & II). The total lipid content in this particular species *Oecophylla smaragdina* was ranges from10-25% in queen larva, 10-23% in queen pupa and 10-20% in queen adult in different seasons of the year. Triglyceride amount was found in maximum amount 166.81 mg/gm in pupal stage of queen ant (Table: V & VI) in the month of March- April and in pupal stage of worker minimum of 47.75mg/gm in the month of January. Cholesterol content was relatively higher in pupal stage in both the caste, 15.22 mg/gm in worker pupa and 10.95 mg/gm in queen pupa. (Table: III & IV). The most interesting point noted in the study as higher amount of cholesterol during winter period (from November to February) (Table: III & IV) in all the stages of both castes. Comparison of mean values showed significant ($p<0.05$) differences between some stage of queen and worker caste. In case of cholesterol content seasonal impact was not so prominent but caste wise and stage wise differences were quite notable.

In the present study highest amount of total lipid was recorded as 249.21 mg/gm in queen larva and 129.86 mg/gm in worker larva in the month of March. Yang et al. (2006) reported slightly lower values of lipid in some Thai edible insects as Terricolous and Aquicolous insects.

Significantly higher values of ($p<0.01$) triglyceride and total lipid was observed in all the three stages of Queen caste than those of the worker caste during the peak seasons of availability (March to June) of the year. However, the increase was also exhibited in some parts of other seasons of the year (November to February) with lower magnitude. Similar findings were observed in case of cholesterol content though magnitude of difference was not so high and uniform increase or decrease was not depicted in the present study. Impact of seasonal variation was also not clearly observed in case of cholesterol content as the results showed some amount of fluctuation throughout the experiment. But it can be opined from the present study that *Oecophylla smaragdina* can be a rich source of fat with higher amount of total lipid and triglyceride

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Table-I: Mean and ±SD of Total lipid (mg/gm) in different developmental stages of *Oecophylla smaragdina*,Fabricius

		March	April	May	June	November	December	January	February
Queen larva	Mean	249.21	230.51	228.81	217.81	112.61	98.56	98.76	111.71
	±SD	56.79	51.30	51.88	49.42	25.30	22.11	22.12	25.09
Queen pupa	Mean	228.93	213.93	209.13	165.28	107.76	95.66	95.06	10.11
	±SD	52.16	47.96	47.37	36.81	24.07	21.09	21.29	24.00
Queen adult	Mean	203.06	207.25	203.56	120.86	102.06	90.66	91.96	105.16
	±SD	46.14	46.61	45.75	26.87	23.04	20.12	20.35	23.45
Worker larva	Mean	129.86	123.26	119.36	115.01	104.61	104.96	102.86	96.36
	±SD	29.04	27.55	26.71	25.74	23.62	23.71	23.05	21.46
worker pupa	Mean	133.06	128.06	116.31	117.66	108.46	99.91	98.96	90.66
	±SD	29.62	28.37	26.03	26.36	24.33	22.42	21.96	20.21
Worker adult	Mean	123.21	118.71	113.21	105.96	98.61	89.21	84.21	73.21
	±SD	27.18	26.31	25.45	23.56	22.18	19.90	18.75	16.51

Table -II: Showing significance of differences in the mean values of Total lipid (mg/gm) between the different developmental stages of two castes of *Oecophylla smaragdina* Fabricius

Months	**Differences**	**Queen**			**Worker**			**Queen Larva and Worker Larva**	**Queen Pupa and Worker Pupa**	**Queen Adult and Worker Adult**
		Larva and Pupa	**Larva and Adult**	**Pupa and Adult**	**Larva and Pupa**	**Larva and Adult**	**Pupa and Adult**			
March	t	1.18	2.82	1.66	-0.35	0.75	1.10	8.37	7.15	6.67
	p	>0.05	<0.05	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
April	t	1.05	1.49	0.45	-0.54	0.39	0.80	8.18	6.89	6.17
	p	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
May	t	1.25	1.63	0.38	0.37	0.75	0.38	8.39	7.68	7.72
	p	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
June	t	3.81	7.71	4.36	-0.04	1.16	1.48	8.25	4.70	1.86
	p	<0.05	<0.05	<0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
November	t	0.62	1.38	0.77	-0.51	0.83	1.34	1.03	-0.09	-0.48
	p	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05
	df	38	38	38	38	38	38	38	38	38
December	t	0.42	1.14	0.72	0.69	2.28	1.60	-0.88	-0.62	0.28
	p	>0.05	>0.05	>0.05	>0.05	<0.05	>0.05	>0.05	>0.05	>0.05
	df	38	38	38	38	38	38	38	38	38

January	t	0.54	1.01	0.47	0.55	2.81	2.22	-0.57	-0.57	1.25
	p	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	>0.05	>0.05	>0.05
	df	38	38	38	38	38	38	38	38	38
February	t	0.59	0.85	0.26	0.86	3.82	2.99	2.01	2.34	4.98
	p	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38

Table- III: Mean and ±SD of Cholesterol (mg/gm) in different developmental stages of *Oecophylla smaragdina,* Fabricius

		March	April	May	June	November	December	January	February
Queen larva	Mean	4.66	5.12	9.83	8.87	6.29	8.79	8.12	8.37
	±SD	0.77	0.72	1.71	1.57	1.06	1.63	1.42	1.49
Queen pupa	Mean	10.95	8.75	11.34	9.26	8.21	8.56	8.58	9.19
	±SD	2.05	1.65	2.02	1.72	1.49	1.53	1.59	1.66
Queen adult	Mean	6.22	4.79	8.89	6.59	5.25	5.75	5.63	7.71
	±SD	1.06	0.84	1.55	1.07	0.83	0.97	0.95	1.33
Worker larva	Mean	7.28	6.23	7.45	7.89	6.92	8.97	8.97	6.61
	±SD	1.20	1.08	1.25	1.37	1.15	1.67	1.67	1.14
worker pupa	Mean	15.22	8.21	9.51	10.12	7.79	9.33	8.29	7.52
	±SD	8.91	1.50	1.78	1.86	1.36	1.72	1.50	1.36
Worker adult	Mean	3.97	5.69	6.63	6.33	4.57	4.79	4.98	5.55
	±SD	0.66	0.85	1.09	1.01	0.70	0.75	0.79	0.88

Table -IV: Showing significance of differences in the mean values of Cholesterol (mg/gm) between the different developmental stages of two castes of *Oecophylla smaragdina* Fabricius

Months	**Differences**	**Queen**			**Worker**			**Queen Larva and Worker Larva**	**Queen Pupa and Worker Pupa**	**Queen Adult and Worker Adult**
		Larva and Pupa	**Larva and Adult**	**Pupa and Adult**	**Larva and Pupa**	**Larva and Adult**	**Pupa and Adult**			
March	t	-12.84	-5.20	9.10	-3.96	11.03	5.64	-8.29	-2.09	7.95
	p	>0.05	>0.05	<0.05	>0.05	<0.05	<0.05	>0.05	>0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
April	t	-8.80	1.25	9.33	-4.80	1.71	6.51	-3.70	1.08	-3.32
	p	>0.05	>0.05	<0.05	>0.05	<0.05	<0.05	>0.05	>0.05	>0.05
	df	38	38	38	38	38	38	38	38	38
May	t	-2.59	1.84	4.33	-4.20	2.19	6.14	7.16	3.05	5.33
	p	>0.05	<0.05	<0.05	>0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
June	t	-1.47	5.37	6.78	-4.21	4.03	7.90	2.09	-0.88	0.78
	p	>0.05	<0.05	<0.05	>0.05	<0.05	<0.05	<0.05	>0.05	>0.05
	df	38	38	38	38	38	38	38	38	38
November	t	-5.33	3.93	7.64	-2.51	8.86	8.78	-2.10	1.21	1.89
	p	>0.05	<0.05	<0.05	>0.05	<0.05	<0.05	>0.05	>0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
December	t	0.45	6.97	6.82	-0.67	10.14	10.70	-0.34	-1.48	3.39
	p	>0.05	<0.05	<0.05	>0.05	<0.05	<0.05	>0.05	>0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
January	t	-0.96	6.65	7.15	1.33	9.68	8.55	-1.74	0.58	2.46
	p	>0.05	<0.05	<0.05	>0.05	<0.05	<0.05	>0.05	>0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
February	t	-1.64	1.48	3.09	-2.35	3.35	5.46	4.27	3.48	5.99
	p	>0.05	>0.05	<0.05	>0.05	<0.05	<0.05	<0.05	<0.05	<0.05

	df	38	38	38	38	38	38	38	38	38

Table-V: Mean and ±SD of Triglyceride (mg/gm) in different developmental stages of *Oecophylla smaragdina*, Fabricius

		March	April	May	June	November	December	January	February
Queen larva	Mean	127.07	130.62	129.59	107.69	81.72	74.43	58.77	61.31
	±SD	28.60	29.20	6.07	24.00	18.24	16.48	13.04	13.57
Queen pupa	Mean	166.81	145.13	97.81	136.47	79.98	75.56	62.49	64.66
	±SD	37.22	32.35	21.77	30.60	17.77	16.63	13.19	14.32
Queen adult	Mean	100.44	98.57	98.54	79.63	63.67	64.53	58.69	59.52
	±SD	22.30	21.70	21.78	17.50	14.12	14.09	13.03	13.12
Worker larva	Mean	74.78	75.27	73.88	71.59	72.33	60.47	59.59	58.49
	±SD	16.44	16.43	16.16	15.69	15.97	13.29	13.21	12.93
worker pupa	Mean	81.59	78.69	82.39	87.15	69.51	64.23	63.27	62.29
	±SD	17.86	17.19	17.95	19.24	15.28	14.09	14.01	13.79
Worker adult	Mean	78.58	70.33	66.86	67.29	62.75	59.89	47.75	57.59
	±SD	17.06	15.46	14.35	14.76	13.79	13.29	10.48	12.76

Table -VI: Showing significance of differences in the mean values of Triglyceride (mg/gm) between the different developmental stages of two castes of *Oecophylla smaragdina* Fabricius

Months	**Differences**	**Queen**			**Worker**			**Queen Larva and Worker Larva**	**Queen Pupa and Worker Pupa**	**Queen Adult and Worker Adult**
		Larva and Pupa	**Larva and Adult**	**Pupa and Adult**	**Larva and Pupa**	**Larva and Adult**	**Pupa and Adult**			
March	t	-3.79	3.28	6.84	-1.25	-0.72	0.54	7.08	9.24	3.48
	p	>0.05	<0.05	<0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
April	t	-1.49	4.05	5.48	-0.64	0.98	1.62	7.39	8.12	5.00
	p	>0.05	<0.05	<0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
May	t	3.92	3.83	-0.11	-1.58	1.45	3.02	6.29	2.44	5.43
	p	<0.05	<0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
June	t	-3.31	4.23	7.21	-2.80	0.89	3.66	5.63	6.10	2.41
	p	>0.05	<0.05	<0.05	>0.05	>0.05	<0.05	<0.05	<0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
November	t	0.31	3.50	3.22	0.57	2.03	1.47	1.73	2.00	0.18
	p	>0.05	<0.05	<0.05	>0.05	<0.05	>0.05	<0.05	<0.05	>0.05
	df	38	38	38	38	38	38	38	38	38
December	t	-0.22	2.04	2.26	-0.87	0.14	1.00	2.95	2.77	1.07
	p	>0.05	<0.05	<0.05	>0.05	>0.05	>0.05	<0.05	<0.05	>0.05
	df	38	38	38	38	38	38	38	38	38
January	t	-0.87	0.02	0.89	-0.86	0.83	3.97	-0.20	-0.18	2.93
	p	>0.05	>0.05	>0.05	>0.05	>0.05	<0.05	>0.05	>0.05	<0.05
	df	38	38	38	38	38	38	38	38	38
February	t	-0.76	0.42	1.18	-0.90	0.22	1.12	0.67	0.53	0.47
	p	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05
	df	38	38	38	38	38	38	38	38	38