PRODUCTIONAL PERFORMANCE OF CROSSBRED (SAANEN & NUBIAN) GOATS IN THE SECOND KIDDING UNDER SUDAN CONDITIONS

By

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وقل ربى زدنى علماً

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Dedication

This work is dedicated with gratitude to my family and all friends with love.

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CHAPTER ONE

INTRODUCTION

The goat was probably the first animal to be domesticated (around 9000-7000 BC). This long association between goat and humans indicates the variety of functions the goat can provide (Devendra and Mcleroy, 1982). Moreover, goats are found in all types of environments from arid to humid zones and they do very well in the drier tropics. This because of their ability to withstand dehydration and their browsing habit enable them to survive, where cattle and sheep cannot (Steele, 1996). Hence, goats are kept to provide human nutrition as well as possibilities of earnings, especially in times of economic crisis (Peter and Horst, 1981).

Ibrahim (2000) cited that the indigenous goats in the tropics are well known for their tolerance of the environment. He also added that goats generally exhibit low productive and reproductive performance

According to the latest estimate of livestock in Sudan there are about 40.719 million heads of goats (Ministry of Animal Resources, 2002). Four local breed types of goats are known in Sudan: Nubian (the only specialized dairy goat), Desert, Nilotic dwarf and Tegri (Hassan and Elderani, 1990).

The importation of exotic dairy goat breeds from temperate regions in an effort to meet the need for fresh milk production failed, because of inability of these breeds to tolerate the local environment, management and endemic diseases (Vaccaro, 1974). Therefore, crossbreeding is recommended, and this is not only due to the fact that cross breeding has the advantage of being the quickest breeding method for improving genetic potentials for production, but it exploit the non additive gene action (Stemmer *et al*, 1998). Saanen goats have been used with success to increase milk yields of the indigenous tropical breeds of goats where

adequate year-round feeding is assured (Gol, 1996). Hence, the objective of this dissertation is to study the performance (birth weight, body weight, and milk yield and milk composition) of crossbred between Saanen and Nubian (50%) in the second kidding under Sudan condition.

CHAPTER TWO
LITERATURE REVIEW

2.1 IMPORTANCE OF GOATS

Interest in the value of goats as domestic livestock is presently widespread. Moreover, it has been stimulated by a wide recognition of their role in food production, their economic importance in the tropics and subtropics where they are concentrated, and the fact that they constitute an important component of traditional farming systems (Devendra, 1985). Devendra (1990) reported that the developing countries produce as 92.8 %, 73.2 % and 93.9 % of the total meat, goat milk and fresh skins respectively. In temperate countries, where goats are used primarily or exclusively for milk production, claims have been made that goat milk has important advantages over cow milk for human nutrition (Devendra and Burns, 1983). They also added that the efficiency of milk production in dairy cows and goats is approximately the same. However in many developing countries goat's milk can be produced more efficiently using limited resources. Moreover goats produce a relatively higher milk yield per unit of live weight compared to cows and buffaloes (Devendra and Mcleroy, 1982). Goats are notoriously active and persistent and posses well-proven powers of endurance. Also, they can withstand the heat of the tropical sun or the cold of winter mountain conditions in temperate areas (Frensh, 1970). Similarly Haas and Horst (1979) reported that goat's posse's physiological and anatomical attributes, which enable them to adapt better than other domestic animals to extreme local conditions. They also added that the specific traits, which can be mentioned in this connection, are acclimatizability and water balance, feeding behavior and digestive ability. Hence their significant contribution to less developed regions continues unabated (Frensh, 1970). With respect to goat's milk,

Mackenzie (1967); Frensh (1970); Devendra and Burns (1983) and Steele (1996) claimed that the goat's milk used with advantage to replace cow's milk in the diet of those suffering from allergy to cow's milk and other staple foods. Moreover, goat's milk is finer than cow's milk; the fat and protein are present in a more finely divided state and are very much more easily digestible (Mackenzie, 1967 and Steele, 1996). Eventually, in the tropics goats are rarely kept just for milk but goat's meat and goat's milk products are of great importance in subsistence agriculture (Devendra and Burns, 1983 and Steele, 1996).

2.2 GENERAL DAIRY GOAT BREED

Goats belong to the Bovidae family of hollow-horned ruminants in the suborder Ruminantia of the mammalian order of Artiodactyla (French, 1970 and Devendra and Mcleroy, 1982). French (1970); Devendra and Mcleroy (1982); and Steele (1996) mentioned that goats and sheep (Ovina), which are closely related together, constitute the tribe of Caprini. This tribe is divided into two genera Capra and Hemitragus. The domesticated goat originates from Capra genus, which has 60 chromosomes in their cell, and this includes five groups or species (Steele, 1996). There are some 300 breeds of goats, many of them located in the tropics and subtropics (Devendra and Burns, 1983 and Steele, 1996). Goat breeds are not well recorded in the tropics and are often defined only by the geographical area in which they live (Steele, 1996). Indigenous tropical goats have been classified into large, small and dwarf type (Devendra and Burns, 1983).

A general definition of dairy animal is one, which gives more milk than her offspring require (Devendra and Burns, 1983). The majority of improved dairy goat breeds originate from Europe in the hill farming areas of Switzerland, which are utilized to improve the yields of indigenous populations (Haas and Horst, 1979). Similarly, Anglo-Nubian was

developed out of a combination of British high yielding breeds and Oriental lop-eared breeds (Mason, 1969). However, the Saanen goat is the best-known representative of dairy goat breeds (Haas and Horst, 1979).

2.2.1 Sudanese Nubian goats:

2.2.1.1 Distribation:

They occur in riverine and urban areas of the northern part of Sudan (Gall, 1996). Frensh (1970) and Steele (1996) mentioned that they are found in north Sudan, Egypt, Ethiopian highland and Eritrea. Moreover, Devendra and Mcleroy (1982) reported that the Nubian goat was also found in the uplands of east and South Africa, in Madagascar and several areas of the Western Sahara. Similarly, they stated that this breed could be found in several countries of Latin American and Caribbean. Moreover, this breed is closely related to the Damascus and Syrian mountain goats (Devendra and Burns, 1983 and Steele, 1996).

2.2.1.2 Body conformation and characteristics

The colour is generally black with grey or speckled grey ears (Devendra and Burns, 1983; Gall, 1996 and Steele, 1996). However, Gall (1996) mentioned other colour that range from light fawn to dark chocolate brown. The head is small to medium, forehead is prominent, profile markedly convex in males and usually so in females, depression just behind nostrils, prognathous to some degree (Gall, 1996). Moreover, Gall (1996) and Steele (1996) mentioned that ears are long (25 cm), broad and pendulous. Devendra and Mcleroy (1982) reported that the average height at withers is 70-80 cm. While, Steele (1996) reported that the height at wither is 85 cm. The hair is long according to Devendra and Burns (1983), however, Frensh (1970) claimed that the Nubian goat had short silky hair. The body weight of Nubian goat ranges from 50 Kg to 70 Kg for male and from 40 Kg to 60 Kg for female (Wilson, 1991).

Moreover, Devendra and Burns (1970) mentioned that the body weight of Sudanese Nubian female was 27 Kg.

2.2.1.3 Utility

The principle value of the Nubian goat is in milk production and the average daily milk yield is 1.2 Kg (Devendra and Mcleroy, 1982). The breed is prolific; giving a mean litter size of 1.4, while 1.5 Litres per day is possible with 3% butter fat in its milk yield (Steele, 1996). Moreover, they have a reputation for milk production, although the males are kept for meat (Frensh, 1970).

2.2.2 Saanen goat:

2.2.2.1 Distribution:

This breed originated in west and northwest Switzerland (Frensh, 1970; Devendra and Mcleroy, 1982; Devendra and Burns, 1983 and Gall, 1996). Moreover, Gall (1996) cited that the name was derived from its original home, the Saanen Valley in Switzerland.

2.2.2.2 Body conformation and characteristics:

This is a pure white or pale biscuit coloured large goat, with upright erect ears and a short haired coat (Steele, 1996). Moreover, Devendra and Mcleroy (1982) reported that the breed was polled (hornless). Hermaphroditism is common in this breed, and since this is associated with the gene for polledness, it is advisable in practice to use only horned bucks (Haas and Horst, 1979 and Devendra and Mcleroy, 1982). Gall (1996) cited that heights at whither are 80-95 cm for males, and 75-85 cm for females. Moreover, they reported that the body weight were 75 Kg and 50 Kg for males and females, respectively. However, Devendra and Mcleroy (1982) and Steele (1996) reported that the adult females weigh about 65 Kg.

2.2.2.3 Utility:

The main value of the breed is in milk production and the average daily yield in the tropics is 1-3 Kg, while in temperate regions it can produce up to 5 Kg of milk (Devendra and Mcleroy 1982). Chawla et al (1981) reported that the litter size of Saanen breed was 1.4 in India. In Malaysia, Saanen did not acclimatize as well as Anglo-Nubians, and in Ghana only very low milk yields were obtained, while in Cyprus it was reported that Saanen do well only if kept in the cooler regions (Devendra and Burns, 1983).

2.3 Birth weight:

Birth weight is important because it is strongly correlated with growth rate and adult size, and also with kid viability, therefore it is an important factor affecting productivity (Devendra and Burns, 1983). Chawla *et al* (1981) indicated that the birth weights of Saanen goats in India were 3.72± 0.17 Kg and 3.3±0.11 Kg for males and females respectively. Moreover, Gall (1996) cited that the birth weights ranged between 2.8-3.3 Kg for males and 2.5-3.2 Kg for females in Venezuela. While, with respect to Sudanese Nubian goat, Kudouda (1985) demonstrated that the birth weights were 2.5±0.54 Kg for males and 2.12±0.31 Kg for females. Also he indicated that the birth weights of crossbred (Nubian does X Anglo-Nubian and Toggenburg bucks) were 2.59±0.55 Kg for males and 2.17±0.51 Kg for females. Ibrahim (2000) indicated that the average birth weight of 50%, 62.5% and 75 % (Nubian X Saanen) crossbred kids ranged between 2.1-2.9 Kg for 50% breed, 1.8-4.0 Kg for 62.5% crossbred and 2.5-2.7 Kg for 75% crossbred.

Table 2.1 includes birth weight of crossbred goats as reviewed by Devendra and Burns (1983).

Table 2.1: Birth weight of crossbred goats:

Breed	Location	Birth weight (Kg)			
		Male		Female	
		Single	Twin	Single	Twin
Indonesian×Jamnapari	Malaysia	3.0*		2.6*	
Ethiopian× Saanen	Ethiopia	2.7+			
Malabari ×Saanen	India	2.9+	2.2+		
Saanen × Beetal	India	3.5	3.2	3.8	3.0
Saanen ×(Alpine ×Beetal)	India	3.4	3.6	4.7	3.2
Anglo-Nubian×Katjang	Malaysia	1.6*		1.5*	

*Weighted mean for single and multiple births.

+Weighted mean for both sexes.

2.3.1 Factors affecting birth weight:

The variation in birth weight is due to both genetic and environmental factors (Devendra and Burns, 1983). Moreover, they mentioned that between breed differences were primarily genetic, on the other hand, within breed differences, although partly genetic, were largely due to variation within the environment, especially in nutrition and health. Castillo *et al* (1976) reported that the birth weight of Nubian, Alpine, Toggenburg and Saanen in Venzuela was significantly affected by litter size, parity, sex of kid, year and month of kidding and breed. Elabid (2002) indicated that the mean birth weight of male kids of Nubian goat was significantly higher than that of female kids. Moreover, he reported that the litter size, parity, season of kidding and feed supplementation affected birth weight. The genetic factor significantly affects the body weight at birth and also variation in body weights at birth and up to weaning is affected by year of kidding and type of birth in Beetal and Black Bengal kids and their crosses (Malik *et al*, 1986). They added that

the kid born as a single have a higher mean birth weight (2.1 Kg) than those born either as twins (1.76 Kg) or as triplets (1.35 Kg). Moreover they also reported that the weight of male kids at birth (1.82 Kg) was significantly greater than that of female kids (1.66 Kg). Jagtap *et al* (1990) stated that the sex, type of birth and year and month of birth had significant effects on birth weight in local Indian goat, Angora and their crossbred goats. Gubartalla (1998) reported that irrespective of the sex of the Sudanese Nubian kids; the kids born to group B (Sorghum-based) were higher in birth weight (2.49±0.53 Kg) than group A; Molasses based; (2.41±0.41 Kg) but the difference was not significant. He also found that males are always heavier than female kids at birth in both groups and single birth kids ranked heavier than twins and triplets. Similarly Kudouda (1985) indicated that the birth weight of Sudanese Nubian male kids was slightly higher than that of female kids. However the birth weight of male crossbred kids (Sudanese Nubian female X Anglo-Nubian and Toggenburg males) was significantly higher compared to that of crossbred female kids.

2.4 FACTORS AFFECTING BODY WEIGHT:

The causes of variation of adult live weight are numerous, and include breed differences, litter size, nutrition, cross breeding and interaction between genotype and environment (Devendra and Burns, 1983). Growth rates of young goats can vary from 20 grams to 180 grams daily, although they are generally considered to grow more slowly than lambs, which make it very important factor affecting body weight (Steele, 1996).

Patnaik and Sukader (1988) reported that the difference in body weights at birth and other ages was highly significant among breed (Black Bengal, Ganjam and Jamnpari).

However they reported non-significant variations between sexes under farm condition in Orissa, India. Moreover, Castillo *et al* (1976) reported that the body weight at one year of age of Nubian, Alpine, Toggenburg and Saanen kids was significantly affected by breed. However, Mavrogenis (1983) pointed out in Damascus goat that sex of kid had a significant effect on weaning weight, pre weaning growth rate and 140-day weight. The average daily pre-weaning weights gain of different crossbreeds (50%, 62.5 and 75%) of Nubian X Saanen was 32.7 ±17.3, 38.7±16.3 and 36.5 ± 0.4, respectively (Ibrahim, 2000).

Mittal and Pandey (1978) from data of 62 Barbari kids, they indicated that, although statistically non – significant, male kids were heavier than female kids at every interval from one month to nine months. Similarly Rose *et al* (1992) mentioned that males had heavier live weight than females in Cashmere goat southwest Queen land. Savanna Brown goat – aged 3-4 months given a protein supplement of cotton seed cake attain puberty at an earlier age (190 days) and have higher body weight (10±3 Kg) compared to those given maize and a lower amount of protein supplement (240 days, 9± 0.5 Kg) as estimated by Fasanya *et al* (1992). Kidding and lactation affect live weight in mature Cashmere and Angora does, but the magnitudes of the effect depend on breeding strategy and time of kidding and lactation (Robertson *et al*, 1992). Moreover, they reported that the weight loss during lactation was lowest when kidding occurs at the time of high pasture availability in spring. To the contrary, Wilson (1976) studied southern Darfur goats and reported that season had no significant effect on goat live weight. However, parity and season of kidding have a significant effect on body weight of Anglo-Nubian goat under extensive management in a semi-arid climate (Cabello *et al*, 1991). Similarly, Sanz sampelayo *et al* (1987) indicated that the total and proportional weights were affected

by age, which was the most influential factor in the Granadina breed. The castrated Angora goats in oak Savannah-Edwards plateau location-are heavier in August than the same goats in February (Lupton *et al*, 1996). Mavrogenis (1983) reported about Damascus goats that type birth had significant effect on weaning weight, pre-weaning growth rate and 140 days weight but had no significant effect on post weaning growth rate. Kids born in single births have higher down weights and coarser down than those born in multiple births (Rose et al, 1992). Mukherjee *et al* (1979) distinguished between brown and grey Bengal, and found that various groups of goats ranging in age between three months to over three years, body weight, length and chest circumference were significantly larger in brown than in grey animals.

2.5 MILK YIELD: -

Steele (1996) mentioned that the lactation curve for milk produced by goats is relatively flat. Moreover, he stated that it peaked at 8-10 weeks from kidding, whilst the cow or buffalo peaked at 4 – 6 weeks. Webster and Wilson (1966) stated that, in the goat, maximum daily milk yield is not reached until between the eighth and twelfth weeks after kidding giving a flatter lactation curve than in the cow. This is agreement with the lactation curve illustrated by Mackenzie (1980). Milk yield increases rapidly post – kidding till it reached its peak at 2nd month, then it declined gradually during the 3rd and 4th months of lactation (Gol, 1996 and Ibrahim, 2000). Gol (1996) reported that the mean daily milk yield was 2.79±0.39, 0.79±0.11 and 0.67±0.16 Kg for crossbred, Nubian goat and Saanen breeds, respectively. Moreover, he claimed that the crossbred (Saanen X Nubian) had 2.55 Kg as mean daily milk yield in second lactation. While Ibrahim (2000) demonstrated that the average daily milk yield for the first 4 months (16 weeks) of Nubian, 25% and 50% crossbred

(Nubian X Saanen) were 0.41±0.09, 0.49±0.07 and 0.51± 0.11 litres, respectively.

Gol (1996) found that the length of lactation in Nubian, Saanen and their crossbred were 76.3 day, 256.4 day and 274 days, respectively. Frensh (1970) reported that Saanen goats in Switzerland yielded 530 Kg in 264 days for first lactation and in subsequent lactation produced 684 Kg in 273 days (the average in the first one is 2.01 Kg/day and in subsequent lactation is 2.51 Kg/day). The average daily milk yield of pure Saanen goat under Sudan condition is 0.95±0.35 Kg and peak milk production occurs in the second month of lactation, then falling gradually towards the end of lactation period (Gol and Abdalla, 1997).

Sommerfeld (1993) demonstrated that milk yield averaged 681 Kg in Anglo-Nubian goat. Sigwald (1993) recorded in France, during 1991-1992, that lactation length averaged 248, 255 and 243 days and yielded 665, 709 and 623 Kg milk, respectively for Alpine, Saanen and their crossbred (Alpine X Saanen). The average milk yields of Alpine; Saanen and their crossbred (Alpine X Saanen) were estimated as 885, 628 and 566 Kg milk, with lactation duration of 240, 246 and 236 days respectively (Montigny *et al*, 1990). Crosses of Alpine, Granada, Anglo-Nubian, Saanen and Toggenburg sires with local Mexican goats were shown that the Alpine, Saanen and Toggenburg crosses had greater milk yield (459, 428 and 422 Kg respectively), lactation length (251, 244 and 259 days) than Granada (353 Kg, 237 days). While Anglo-Nubian crosses revealed milk yield of 370 Kg in 230 days compared to local does that produce milk yield of 299 Kg in 288 days (Montaldo *et al*, 1995). Mittal *et al* (1977) reported that the average daily milk yield in the first ten weeks of lactation was higher in Jamnapari (1.31 Kg) than in Barbari (1.09 Kg). At Kerala, a Malabari goat gives a peak yield of 2.7 Kg daily, which occurred in first week of lactation. Moreover, the average lactation yield is 38.6±3.7

Kg with an average lactation length of 117.5±12.8 days (Devendra and Burns, 1983).

2.5.1 FACTORS AFFECTING MILK YIELD

2.5.1.1 Body weight

Elnaim (1979) showed a positive correlation (r=0.57) between doe weight and average daily milk yield which may indicated a significant influence of doe weight on milk yield of Nubian goat. Milk yield was affected significantly by doe weight (the coefficients of correlation and regression are 1.12 and 0.8) in Nubian goats and crossbred (Nubian X Saanen) respectively (Ibrahim, 2000).

2.5.1.2 Persistency of lactation:

Gubartalla (1998) claimed that the lactation curve of Sudanese Nubian goat increased rapidly post-kidding and peaked at the end of the second month. He also reported that it sustained a high level during the third month and decline sharply during the fourth and fifth month of the lactation period. Gol and Abdalla (1997) found that the peak milk production of Saanen goat under Sudan condition occurred in the second month of lactation, then falling gradually towards the end of lactation period. Similarly, Mackenzie (1967) and Frensh (1970) reported that goats reached their peak milk yield 8 -12 weeks after kidding.

2.5.1.3 Age:

The effects of parity and age of doe on milk yield are well established, although they can be obscured by differences in management, season, nutrition, disease and other environmental factors (Devendra and Burns, 1983). The data of Mittal *et al* (1977) indicated higher yields after four years of age than in younger does. The daily milk increases from 0.46 Kg when Nubian does are about 2 years of age, to 0.55 Kg, when they reach 3 years of age (Elnaim, 1979). He also noticed that daily milk yield

increased further to 0.59 Kg at older ages, when does are 4 years of age or over.

2.5.1.4 Season:

Verma and Chawla (1987) reported that for Beetal, Alpine, Saanen, Alpine X Beetal, Saanen X Beetal and Saanen X (Alpine X Beetal) goat, daily milk yield was significantly higher in females kidding in spring than at other times, except for Beetal goat, which showed the highest occurrence in winter. There are differences between average milk yields of Nubian goats kidded in different season of different years (Elabid, 2002). Moreover, he reported that goats kidded in the winter of the year 1998 showing the highest yields (109.46±31.93 Kg) as compared with the other, however goats that kidded in the dry summer 2000 recorded the lowest yield (61.4± 26.06 Kg). While, Elnaim (1979) reported that the average of the summer and winter kidder were similar (0.55 Kg).

2.5.1.5 Breed:

The breed and type of goat is the most important factor affecting milk yield (Steele, 1996). Table 2.2 includes yields and lactation lengths of different breeds in the world as reviewed by Gall (1996). This table has shown the effect of breed and lactation length.

Table: 2.5 Milk yields and lactation lengths of different breeds in the world

Breed	Country	Yield (Kg)	Days
Alpine	USA	949	259
Toggenburg	Tanzania	250	212
Maltese		900	150-210
Zaraibi	Egypt	69.57±4.98	102
Damascus	Syria	392	238
	Syria	270.8	229
Sahel	West Africa	100-120	120

Boer		228.1±1.6	120
Angora	Turkey	35-40	
Beetal	India	194.9±3.7	187±3.02
Barbari	India	107.1±3.3	150±5.3
Anglo-Nubian	USA	774	237

2.5.1.6 Nutrition:

Nutrition is the next most important factor affecting milk yield (Steele, 1996). The average daily milk yield for goat group A, B, and C (divided according to the level of energy in their diets) are 0.38±0.07, 0.48±0.08 and 0.55±0.1 Kg, respectively. Then the effect of energy intake is found to be significant and their mean differences are significant (Ibrahim, 2000). Similarly Elabid (2002) demonstrated that there were highly significant differences between total milk yields of Sudanese Nubian goats at different nutritional supplements.

2.5.1.7 Litter size:

Nannies with twins or triplets will produce a higher total yield than those with singles but as this milk is shared, single kids will drink more and grow more quickly than twins or triplets (Steele, 1996). The yield of the Nubian does rearing twins averaged 0.64±0.01 Kg /day compared to 0.5±0.02 Kg /day yielded by those rearing singles (Elnaim, 1979). Skinner (1972) found that in Boer goats the average total milk yield for does with single kid being 160.3 Kg and that with twins were 228.1 Kg with average daily production of 1.77 and 1.81 Kg respectively. Goat with average daily two or more kids at birth has greater milk yield, milk efficiency and body weight than goats with one kid (Montaldo *et al*, 1995).

2.5.1.8 Udder conformation:

Udder volume is highly correlated with milk yield (Devendra and Burns, 1983). Bigger udders have a higher production capacity but may be prone to physical damage whilst the nanny is grazing (Steele, 1996).

A parameter analysis shows that udder circle, udder column width, udder front depth, full volume and empty volume have high heritabilities, high correlation with milk yield (Wang, 1989). Moreover, he reported that all phenotypic and genetic correlations were positive and high, and it is suggested that selecting for these six characteristics can increase that milk yield. Mammary glands increase in size form the first to the fifth lactation that means the milk production depends on udder size and hormonal stimuli (Harding, 1999)

2.5.1.9 Dry period:

The dry period almost equals the length of pregnancy, suggesting that the goats may have difficulty in sustaining lactation when in kid (Rana, 1980 and India, 1976). However another report from India (Bhatnagar and Mishra, 1977) shows that this is not necessarily the case, with Saanen X Beetal crossbreds averaging only 42 days dries.

2.6 MILK COMPOSITION:

Goat's milk is made up of fat, protein, lactose and water, and it has a pure white appearance when fresh (Steele, 1996). Differences occur between breeds and between individuals within breeds, as well as due to stage of lactation, and environmental factors such as nutrition (Devendra and Burns, 1983). Goats milk composition varies appreciably according to the breed, the locality, the stage of lactation, the season of the year, the feeding and management, the incidence of oestrus and the state of health of the nanny, consequently and perhaps even more so than with cows, Also there can be significant variation between individuals (Frensh, 1970). Table 2.3 presents data on gross composition from a number of breeds in tropical countries as reviewed by Devendra and Burns (1983).

Table 2.3: Gross composition from a number of breeds in tropical countries.

Fat %	Protein %	Lactose %	Ash %	Total Solids %	Breed	Country
4.7	5.8	4.4	0.72	15.2	Black Bengal	India
3.8	4.1	4.4	0.82	12.7	Barbari	India
4.21	3.75	4.76	0.82	13.54	Barbari& Jamnpari	India
5.42	3.8	4.2	0.728	12.42	Malabari	India
6.9	3.9	6.3	0.8	17.9	W. African Dwarf	Nigeria
7.78	5.3	5.19	0.78	18.18	W. African Dwarf	Nigeria
5.32	4.74	4.77	-	15.85	Red Sokoto	Nigeria
3.34	3.04	4.56	0.75	12.25	Saanen	Nigeria
3.42	2.9	4.38	0.78	11.49	British Alpine	Trinidad
4.06	3.4	4.05	0.79	12.17	Anglo-Nubian	Trinidad
6.0	4.4	4.8	-	15.97	Angora	Turkey
3.54	5.0	5.77	0.79	15.13	Katjang	Malaysia
3.65	4.1	3.52	0.48	11.75	Anglo-	Malaysi

					Nubian	a
2.64	4.1	3.59	0.44	11.77	Saanen	Malaysia
2.65	3.7	4.02	0.30	10.67	Toggenburg	Malaysia

2.6.1 Fat content:

The average fat content is 3.7±0.66 % in Saanen goat's milk under Sudan condition (Gol and Abdalla, 1997). Ibrahim (2000) estimated that the fat % were 4.05±0.76, 3.64±0.42 and 3.4±0.54 in Nubian goat's milk, crossbred (0.75 Nubian X 0.25 Saanen) and (0.50 Nubian X 0.50 Saanen) respectively. The fat % of milk of cross Saanen goats is 3.83±1.04%, and the correlation is positive (r=0.7715) among fat and total solids in milk content in Brazil (Chornobai *et al*, 1999). Similarly, Prata *et al* (1998) estimated that the percentage milk fat averaged 3.74 in Saanen goat in the southeastern region of Brazil. Sung *et al* (1999) reported that the percentages of fat's milk of four goat breeds: Alpine, Nubian, Saanen and Toggenburg were 3.54±1.01, 4.48±1.24, 2.55±0.66 and 3.54±0.96 respectively in Taiwan. Moreover, in Alpine, Saanen and their crossbred the milk yield averaged 588, 628 and 566 Kg respectively, the fat concentration were 32.7, 30.9 and 31.8 gram/Kg respectively in France goat (Montigny, 1990). Sigwald (1993) reported that the fat yields were 22.9, 22.7 and 20.4 Kg in Alpine, Saanen and their crossbred. Where milk yields were found to be 665, 709 and 623 Kg per lactation period respectively. Elnaim (1979) and Kudouda (1985) stated that the fat % of Nubian goat's milk were 3.61 % and 3.39 % respectively in Sudan. Anglo-Nubian goat's yield was 681 Kg and its milk fat content was 31.7 Kg in temperate region (Sommerfield, 1993).

2.6.2 Protein content:

The protein contents are 3.41±0.43, 3.25±0.52 and 3.7±0.47% in Nubian, crossbred (0.25 Saanen X 0.75 Nubian) and (0.50 Saanen X 0.50 Nubian) respectively, in Sudan (Ibrahim, 2000). Gol and Abdalla (1997) stated that the protein content was 3.43±0.37 in Saanen breeds under Sudan condition. Elnaim (1997) and Kudouda (1985) estimated that the protein content of Sudanese Nubian goat's milk were 3.42 and 3.46 % respectively, in Sudan. The protein yield is 25 Kg from 681 Kg milk yield in Anglo-Nubian goat's milk (Sommerfield, 1993). In Taiwan, the protein for Alpine, Nubian, Saanen and Toggenburg revealed 3.08±0.57, 4.23±1.02, 3.25±0.57 and 3.21±0.59 respectively (Sung *et al*, 1998). In United States livestock, dairy goats have protein content range from 3.69% for Nubian breed to 2.98% for Toggerburg (Haenlein, 1996). Moreover, In cross Saanen goats Chornobai *et al* (1999) obtained 3.34-±0.73 % proteins.

2.6.3 Lactose content:

The lactose content is 4.41±0.56% in Saanen breed's milk under Sudan condition (Gol and Abdalla, 1997). However, for Nubian goat's milk in the Sudan, Kudouda (1985) and Elnaim (1979) found that lactose contents were 4.31% and 4.67% respectively. In evaluation of lactose contents of milk in Alpine, Nubian, Saanen and Toggenburg breeds in Taiwan 4.37±0.34%, 4.16 ±0.63% 4.56±0.19% and 4.16 ±0.46% were found respectively by Sung *et al* (1998). The lactose % of Saanen goat milk in the southeastern region of Brazil averages 4.35% (Prata *et al*, 1998). From morning and afternoon milking of crossbred goats (Anglo-Nubian, Parda Alpine and Saanen crossed with native breeds) in Brejo Paraibano, Brazil during 195 days lactation, the mean value is 4.11 to 4.26 gram/100ml for lactose content (Queiroga *et al*, 1998).

2.6.4 Total solids content:

Nubian breed shows the total solids percent of 12.08, while crossbred (0.25 Saanen X 0.75 Nubian) and (0.50 Saanen X 0.50 Nubian) show 11.86 and 11.93% for total solids respectively under Sudan condition (Ibrahim, 2000). Gol and Abdalla (1997) found the total solids content of Saanen goat's milk under Sudan condition to be 12.18±0.88%. In Nubian goat's milk total solids% are 12.55 (Elnaim, 1979). However, Kudouda (1985) reported that the total solids were 11.98% in Sudan. While, the percentages of total solids in Taiwan were 11.55±1.35 for Alpine breed, 13.56±1.73 for Nubian, 11.06±1.16 for Saanen and 11.61±1.34 for Toggenburg breed (Sung *et al,* 1998). Chornobai *et al* (1999) stated that the total solids content of raw milk samples collected from crossbred Saanen goats was 12.25± 1.94 gram/ 100 grams in Brazil. They also reported a positive correlation for fat/ total solids 0.7715 and protein /total solids 0.6228. Similarly, mean value for total solids is 12.24±0.92 in samples of Brazillian goat milk and total solids are affected by breed, climate and lactation duration (D'-Alessandro *et al*, 1995). They also found that Anglo-Nubian goats produced more concentrated milk than Brown and Saanen goats. The percentage of water of Saanen goat milk in the southeastern region of Brazil is 88.49 from total components of milk (Prata *et al*, 1998). Queiroga *et al* (1998) reported that the total dry extract ranged from 12.75 to 13.9 gram/ 100 grams of milk for morning and afternoon milking of crossbred goats (Anglo-Nubian, Parda Alpine and Saanen crossed with native breeds) in Brazil.

2.6.5 Ash content:

The average ash content is 0.65±0.06 of milk in Saanen goats breed in Sudan (Gol and Abdalla, 1997). While the Nubian goat in Sudan, revealed ash contents of 0.82% and 0.84% according to Elnaim (1979) and Kudouda (1985) respectively. In southeastern region of Brazil, Parta *et al* (1998) reported that the percentage of ash of milk in Saanen goat was

0.74. Queiroga *et al* (1998) reported that the mean value of ash was 0.682 to 0.744 gram/100grams for Anglo-Nubian, Parda Alpine and Saanen crossed with native breeds in Brazil.

2.7 PHYSICO -CHEMICAL PROPERTIES

2.7.1 Freezing point:

Harding (1999) stated that the freezing point of goat's milk was slightly lower than cow's milk, and buffalo's milk that had a freezing point similar to cow's milk. The freezing point of goat's milk is about – 0.580°C, which is lower than that of, cows milk (Parkash and Jennes, 1968). Dharmarajan *et al* (1954) reported a range of – 0.545 to – 0.625 °C for 69 samples from individual goats. They also found that 92% of them falling in the range of – 0.565 to – 0.600°C The freezing point of Saanen goat milk in the South-eastern region of Brazil is – 0.575°H (Prata *et al*, 1998).

2.7.2 Acidity:

The titratable acidity expressed as lactic acid ranges from 0.10 to 0.26% in goat's milk, but most samples fall in the range of 0.11 to 0.18%

Parkash and Jennes, 1968). The acidity of milk samples of cross Saanen goats averaged 12.96±3.64°D in Brazil (Chornobai *et al*, 1999). Moreover, they reported that there was positive acidity/density correlation (r=0.2115). However, the acidity of Saanen goat milk in the southeastern region of Brazil was found to be 16.11°D (Prata *et al*, 1998).

CHAPTER THREE

MATERIAL AND METHODS

3.1 STUDY AREA: -

The experiment of the present study was conducted at Goat Improvement Production Project Farm at Helat Kuku in north– eastern region of Khartoum State. The farm was belonging to the Ministry of Agriculture and Animal Resources of Khartoum State. The herd was established as a model of dairy goat management for provision of improved crossbred does and bucks to areas of Khartoum State.

3.2 HOUSING

Selected animals were kept in a pen, as one group, throughout the experiment. The pen measures 14.5 X 5.25 X 1.16 meters. The roof was 2.85 meters in height and was constructed with corrugated galvanized zinc sheets. The floor was concrete. The pen contains a secured metal buckets for water and feed.

3.3 EXPERIMENTAL ANIMALS

A total of eight females (30-36 months old) at their second kidding were selected for the present study. The goats are crossbred (50%) between female Sudanese Nubian goat and Switzerland Saanen male goat.

3.4 FEED INTAKES

Six hundred grams of concentrate diet was offered daily per animal at 9 a.m. Green Bersem (Alfalfa) was offered at a rate of 400 grams per animal after consuming the concentrate collectively for the entire group. Water was supplied ad-libitum. Ingredients and composition of concentrate diet were Sorghum grains (40%), Wheat bran (40%), Groundnut cake (19%) and salt (1%).

3.5 DATA COLLECTION

3.5.1 Weighing

Live weight (Kg) was taken immediately after parturition for females and their kids, and then every ten days, for does, throughout the experimental period. The weighing was conducted before feeding.

3.5.2 Meteorological data

Meteorological information of temperature and relative humidity during the experimental period was obtained from Shambat Agro. Meteorological Observationary, as shown in Table (3.1)

Table 3.1: Environmental conditions during the experimental period

	Maximum	Minimum	Mean
Temperature °C	36.3	26.0	31.66
Relative humidity %	69.0	18.0	41.06

3.5.3 Feed analysis: -

The samples of concentrate feed were analyzed by chemical analysis according to AOAC (1980). The energy content was estimated according to Ellis (1981) as follows:

ME (MJ/Kg DM) = 0.012 C.P + 0.031 E.E+0.005 C.F + 0.014 N.F.E

Where: -

DM= Dry matter.

C.D= Crude protein.

E.E= Ether extract.

C.F=Crude Fibre.

N.F.E=Nitrogen free extract.

The composition of Bersem revealed 2.1605 MJ/Kg energy, 23% dry matter, 2.82% ash, 4.61% crude protein, 0.33% ether extract, 7.0% crude fibre, and 8.25% nitrogen free extract. While, analysis of concentrate feed was shown in Table 3.2

Table 3.2: Proximate analysis of ingredients and their percentages in the concentrate diet

Item / Ingredients	%	Energy MJ/Kg	DM%	Ash% *	C. P%	E. E%	C. F%	N.F.E %
Sorghum	40	13.115	96.82	2.74	13.2	4.89	6.75	68.44
G.N.Cake	19	12.1871	96.7	6.58	43.5	8.38	10.47	25.67
W.bran	40	11.686	96.06	5.87	16.8	5.86	17.52	48.81
Salt	1	-	-	-	-	-	-	-

*** The percentages of compositions based on dry matter.**

3.5.4 Milk yield

A total of 120 daily milk yields from the eight does were obtained throughout the first 17 weeks (early lactation stage) of the second lactation during June 2002 to November 2002. The does were milked once daily by hands at 8:30 a. m before feeding .The milk yield were recorded in litres.

3.6 MILK COLLECTION

A total of 93 milk samples were analyzed during early stage of lactation started five days from kidding to exclude colostrum. The collection of milk samples was carried out once every ten days until the end of experiment period. Milk sample were collected before milking of the does. The samples were collected after washing the udder in clean bottles, with tight covers to prevent leakage and milk spoilage. The samples were transported in an ice container to maintain the samples at 0–4C°. The samples were brought to the Department of Dairy Production, Faculty of Animal Production, and University of Khartoum Laboratory, where analysis of all samples were conducted on the same day.

3.7 CHEMICAL ANALYSIS

3.7 .1 Determination of fat content

The fat content was determined by Gerber method according to Foley, *et al* (1974). The principle of the method is that the solid in milk other than fat were dissolved by concentrated sulphuric acid and lighter fat separated from the heavier acid solution by centrifuging in butyrometer tubes. The procedure was that ten ml of sulphuric acid (specific gravity = 1.82) was measured into a butyrometer tube. From a well-mixed milk

sample, a sample of milk was withdrawn by 10.94 ml pipette. One ml of amyl alcohol was then added and the lock rubber stopper was inserted securely. With the stopper end up, the butyrometer was grasped at the graduated column by wrapping cloth, and shaken until curd was dissolved. The butyrometer with stopper was placed in a water bath at 68 °C until the number of butyrometer tube placed in the centrifuge had been prepared. Then, the butyrometers were centrifuged at 1100 rev/min. for four minutes and removed and placed in the water bath at 68 °C for three minutes. Then, by manipulating the stopper, each butyrometer was adjusted to a convenient position (the line at which the acid solution meets the liquid fat) and the percentage shown at the bottom of the fat meniscus was readout directly.

3.7.2 Determination of protein content

The total nitrogen was determined by using Kjeldahl method (Marshall, 1992). The total protein content was calculated by the nitrogen content multiplied by 6.38. Ten grams of milk was digested with nitrogen free concentrated sulphuric acid and potassium sulphate (catalyst) in a Kjeldahl digestion flask. Organic matter was oxidized during the digestion and nitrogen was quantitatively converted to ammonium sulphate. After completed digestion, and the content had been cooled, the digest was made alkaline by addition of ten ml of 40% sodium hydroxide
solution. The ammonia formed in the digestion step was thus released from protein nitrogen by titration. The distillate was received in a conical flask containing 25 ml boric acid and Tashiro indicator (methylene blue plus methyl red). When the volume reached 75 ml, the sample was then titrated with N/10 HCL. The protein content was calculated as follows:

$$\text{Protein\%} = \frac{T \times N \times O.014 \times 6.38}{\text{Weight of milk sample}} \times 100$$

Where T = Titrant volume

N = Normality of HCl

3.7.3 Determination of Ash content

The ash was determined by the method of AOAC (1980). The principle of the method is to burn away all the organic matter at a temperature of 540 -550 °C. Five grams was weighed into suiTable dish and evaporated to dryness on steam–bath, then, ignited a muffle at temperature o 550 °C until the ash was free from carbon. When cooled, the porcelain dishes were removed and placed in desiccator to cool and weighed. The ash content was calculated according to the following formula. $\text{Ash\%} = \frac{\text{weight of residue}}{\text{Weight of sample}} \times 100$

3.7.4 Determination of total solids content

The total solids of milk were determined by the modified method of AOAC (Harding, 1999). The measurements were tightly controlled and it relies on oven drying of five grams of milk at 102±1°C for two hours until constant mass was achieved. The constant mass was removed from the oven and cooled in desiccator. The total solids were calculated as follows:

$$\text{Total Solids \%} = \frac{W_1 - W_2}{W_1} \times 100$$

Where: W_1 = weight of the sample before drying.

W_2= weight of the sample after drying.

3.7.5 Determination of lactose content

Lactose was calculated by subtracting the ash content plus protein content plus fat content from the total solids content.

Lactose % =Total solids % ÜÜÜ [Ash% + Protein % + Fat %].

3.8 PHYSICO – CHEMICAL PROPERTIES

3.8.1 Determination of freezing point

The freezing point was measured by means of a thermistor Cryoscope, FISKE (U.S.A). Two ml sample of milk was held in a sample tube and immersed in a bath at – 7°C. The temperature of the sample was measured using a thermistor, centered in the body of the sample, which stirred, by a vibrating stirrer wire. Initially the sample was super-cooled to a bout – 3°C, a pulse of energy causing the stirrer wire to strike the walls of the tube giving a freeze pulse formed ice crystals. Latent heat of fusion was released as the super-cooled milk changes to ice and the sample the super temperature rise to a freezing point plateau at which the freezing point was measured (Harding, 1999).

3.8.1 Determination of acidity

The acidity of milk was determined according to Foley *et al* (1974). Ten ml of milk were measured into a white porcelain dish and five drops of phenolphthalein indicator were then added. This mixture was titrated against N/9 sodium hydroxide until a faint pink colour lasting for not less than 30 seconds was obtained. The titration figure was divided by 10 to give the acidity of the sample expressed as a percentage of lactic acid.

3.9 STATISTICAL ANALYSIS: -

Mean, standard deviation, maximum and minimum values were estimated by using Excel 2000. Similarly the same program was used for the graphical representations of data.

CHARTER FOUR

RESULTS

4-1 BIRTH WEIGHT:

The average birth weight of the kids during the present study was found to be 3.56 + 1.0283 Kg (Table 4.1). The same table also shows maximum weight was 4.8 Kg and the minimum weight was 2.0 Kg.

4-2 BODY WEIGHT:

The average weight of does (Table 4.1) was 33.506 ± 5.533 Kg; the maximum weight was 37.975 Kg, which was reported during the first 10 days following kidding. While, the minimum weight (28.633 Kg) was found between 110-120 days. The average weight curve in this study (Fig. 4.1) shows that the weight declined gradually after kidding at 35 days, then it showed a gradual increase to 33.712 Kg till 105 days. However, the average weight showed sharp decrease from the end of 105 days and continued to the end of the experimental period.

4.3 MILK YIELD AND PERSISTENCY OF LACTATION

The present study comprised lactation records of eight does for 120 days. The average daily milk yield was 1.237 ± 0.339 litres (Table 4.1). The maximum milk yield recorded was 1.359 litres, which was obtained during 40-50 days following kidding. The minimum milk yield (0.968) litre was reported during the first 10 days. The average persistency of lactations curve obtained in this study (Fig. 4.2) shows that milk production started at level of 0.968 litres during the first 10 days and it raises to the maximum level (1.359 litre) in 45 days. Then it showed a slight gradual decline from 50 days and continues to be below from 75 days till 120 days. The correlation between body weight and milk yield revealed a positive value (+ 0.4175) as shown in Table 4.2.

Table 4.1: Production traits of crossbred (Nubian X Saanen) goat in Sudan

Item	Max	Min	Mean	S.D*
Birth weight (Kg)	4.8	2.0	3.56	1.0283
Birth weight (Kg)	37.975	28.633	33.506	5.533

Milk yield (liter)	1.359	0.968	1.237	0.339
Fat (%)	4.943	3.2	4.173	1.399
Protein (%)	5.618	3.126	3.66	0.835
Lactose (%)	5.567	4.56	4.914	0.66
Ash (%)	0.965	0.578	0.733	0.245
Total solids (%)	16.31	12.323	13.481	1.727
Freezing point (C°)	-0.519	-0.608	-0.561	0.036
Acidity	0.256	0.182	0.203	0.035

***Standard deviation**

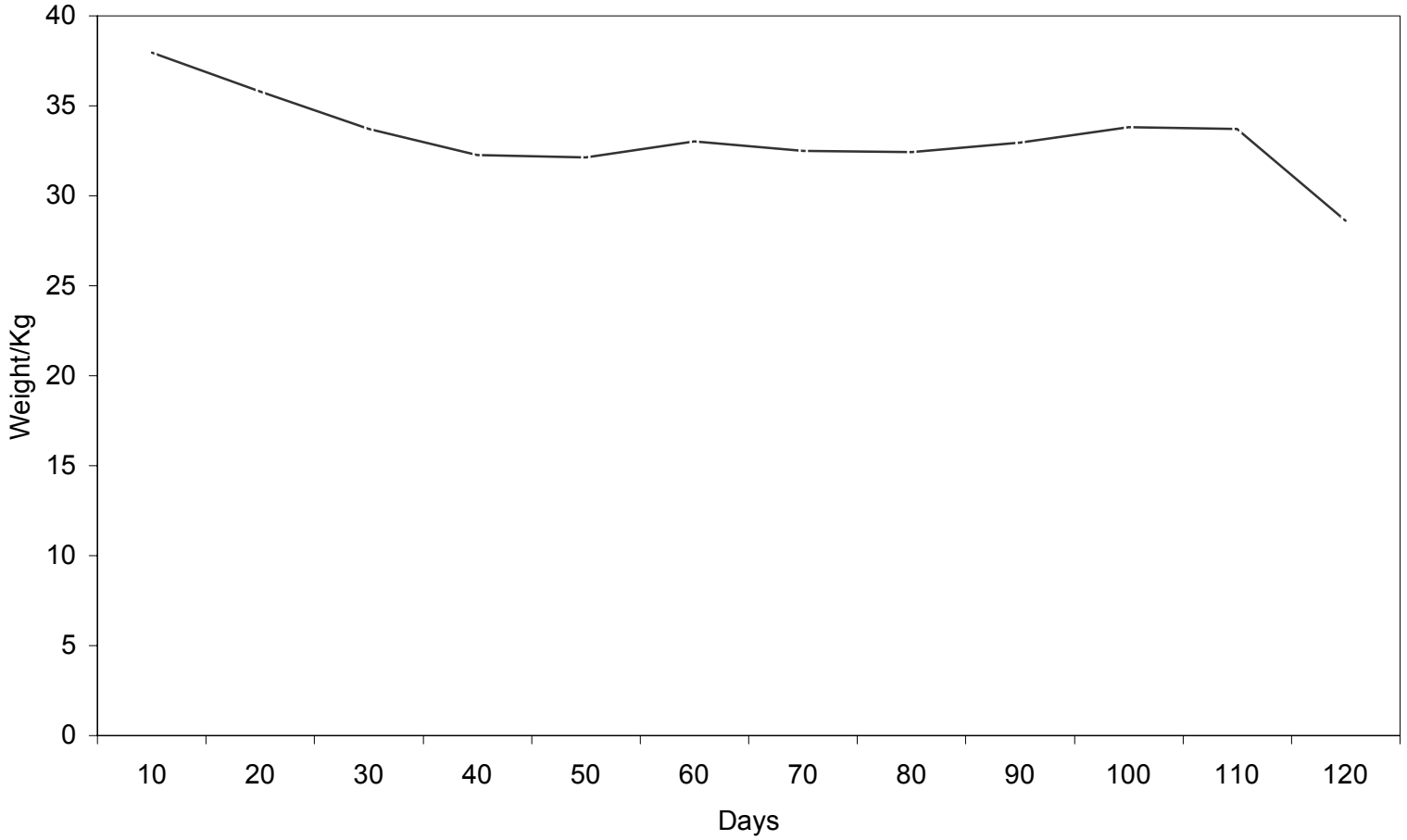


Figure 4.1: The average weight (Kg) of the crossbred (Nubian X Saanen) goat

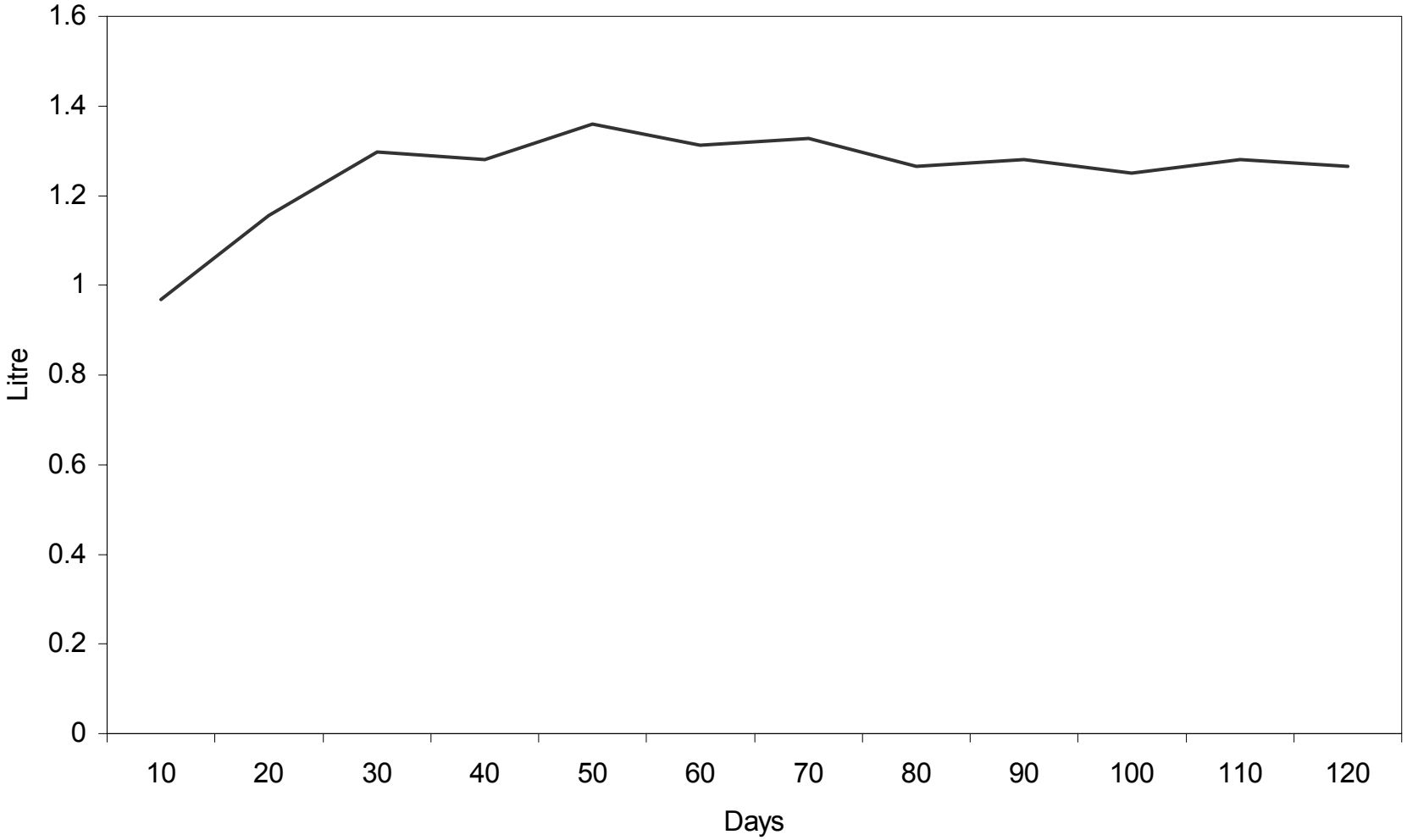


Figure 4.2: The average milk yield (Litre) of the crossbred (Nubian X Saanen) goat

Table 4.2: comparison of correlations between some productional performances of crossbred (Nubian X Saanen) goats

Measurements	***The correlation***
Body weight / Milk yield	0.4175
Body weight / Fat	0.1333
Milk yield /Fat	– 0.0692
Milk yield / Total solid	– 0.1491
Freezing point /Total solid	– 0.3086
Lactose /Freezing point	– 0.2197

4.4 MILK COMPOSITION

4.4.1 FAT CONTENT

The average fat content was 4.173 ± 1.399%; the maximum fat content recorded 4.943%, which was obtained during the first 10 days and the minimum was 3.2%, which was found during 100-110 days (Table 4.1). The average fat (Fig. 4.3) showed irregular pattern, where the curve begins at higher level and then gradually decreased in 35 days. It was again increased after 35 days and decreased gradually until 105 days. Moreover, the correlation between body weight and fat % revealed a positive value (+ 0.1333), while the correlation between milk yield and fat% revealed a negative value (– 0.0692) (Table 4.2).

4.4.2 PROTEIN CONTENT:

The average protein content was 3.66 ± 0.835%; the maximum protein content was 5.618% and the minimum content was 3.126% (Table 4.1). Moreover, the average protein contents (Fig. 4.4) show higher level during the first 20 days. Then it approximately continued in a constant level till 75 days and increased slightly until 85 days.

4.4.3 LACTOSE CONTENT:

The average lactose content was 4.914 ± 0.66%, the maximum content was 5.567% and the minimum was 4.56% (Table 4.1). The average lactose (Fig. 4.5) shows slight regular increase level until 25 days. Then it approximately continued in a constant level till 120 days.

4.4.4 ASH CONTENT: -

The average ash content was 0.733 + 0.2457, the maximum content 0.965% and the minimum content was 0.578% (Table 4.1). The average ash contents (Fig. 4.6) show decreasing rate in 35 days then the ash increased in fluctuation way until 120 days. In general, the ash contents showed an irregular pattern throughout the study period.

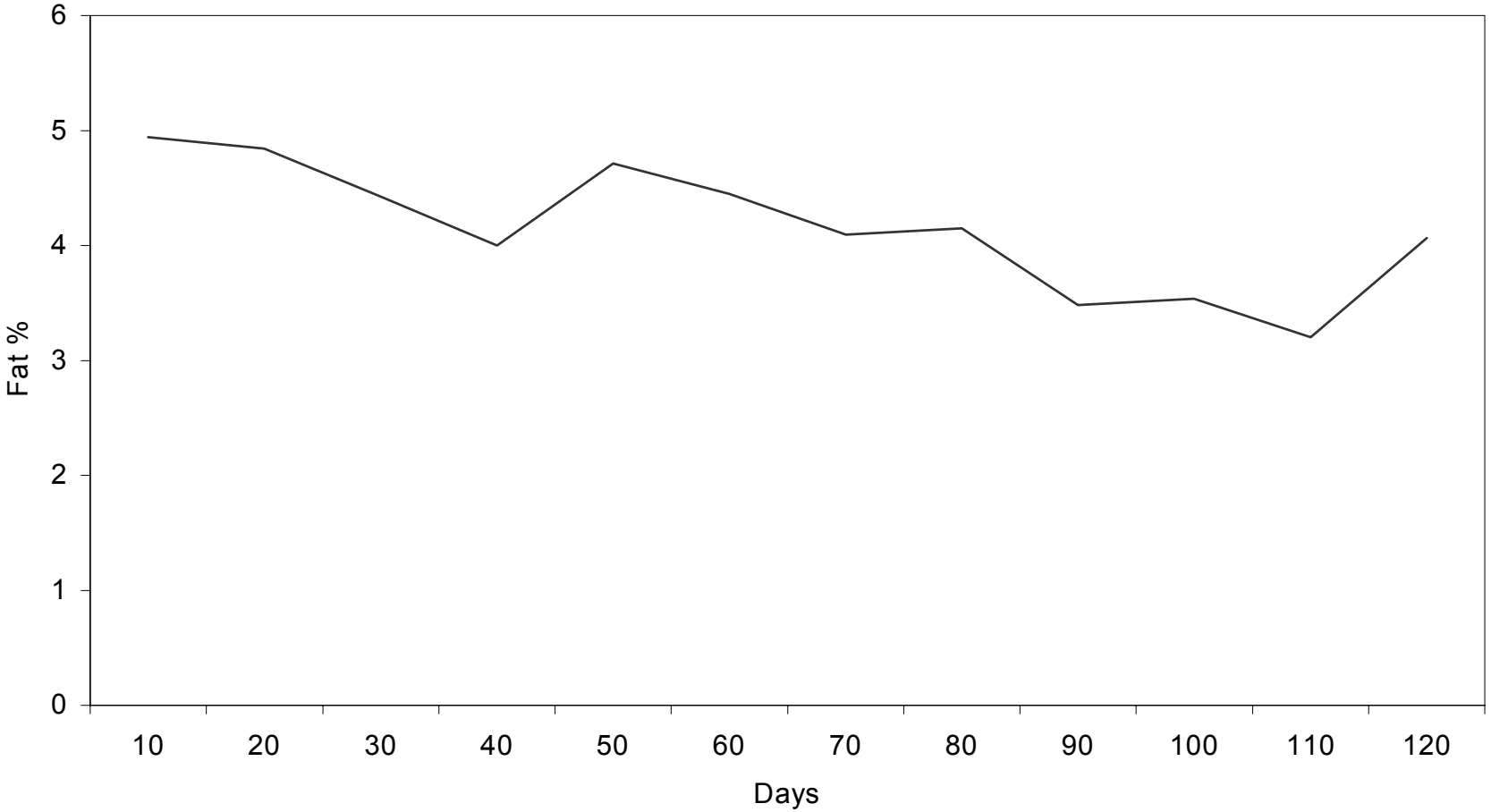


Figure 4.3: The average fat %of crossbred (Nubian X Saanen) goat's milk

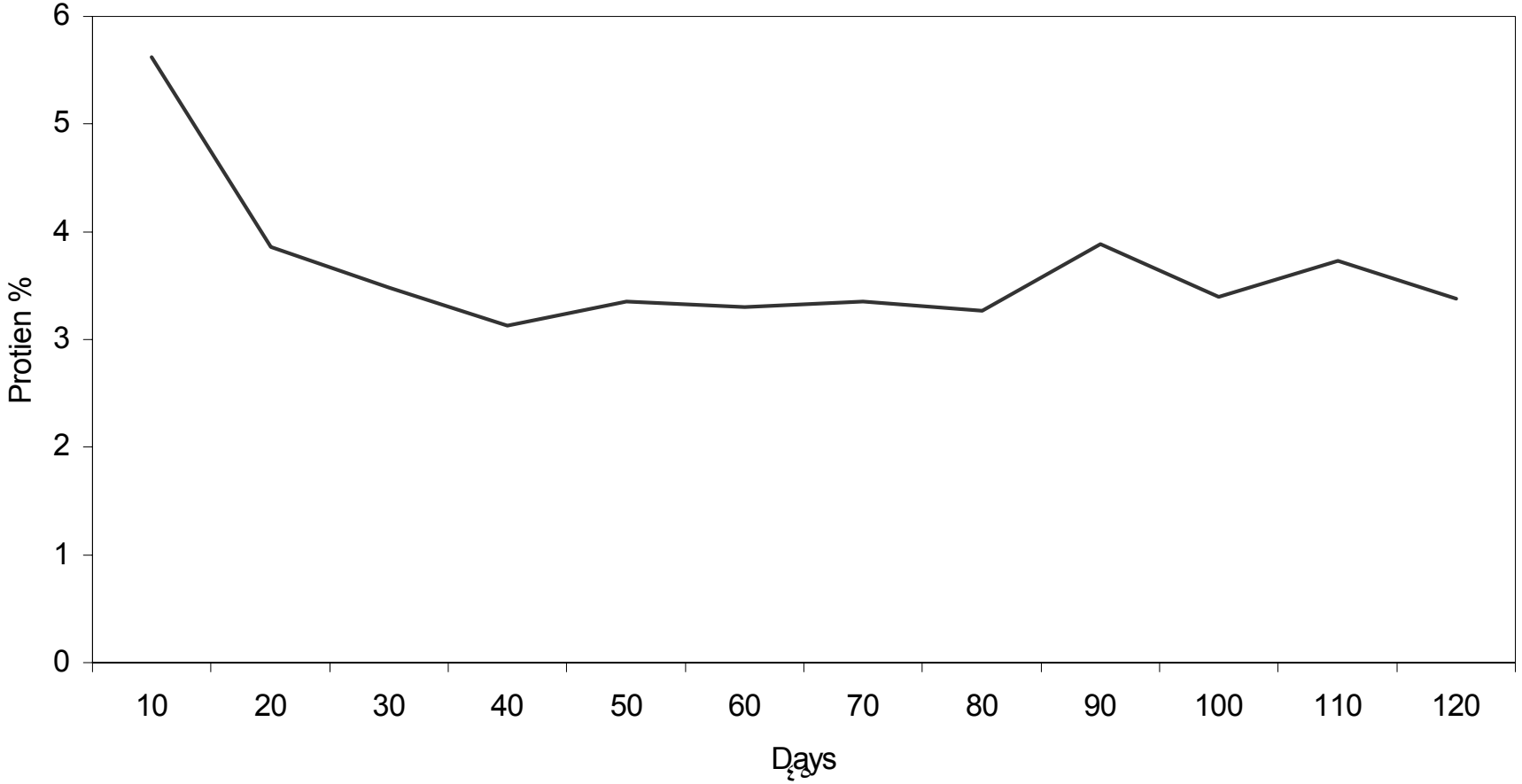
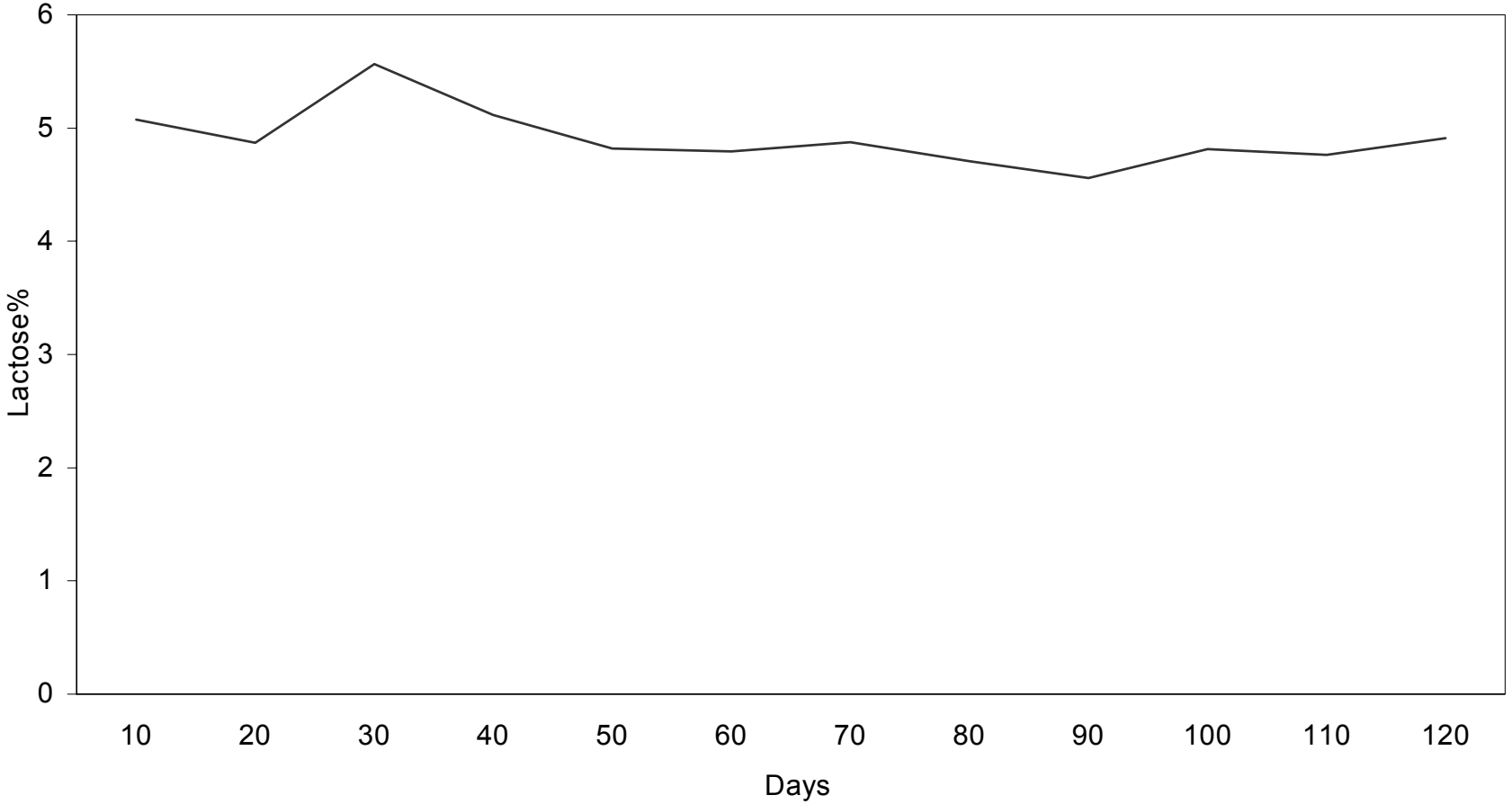
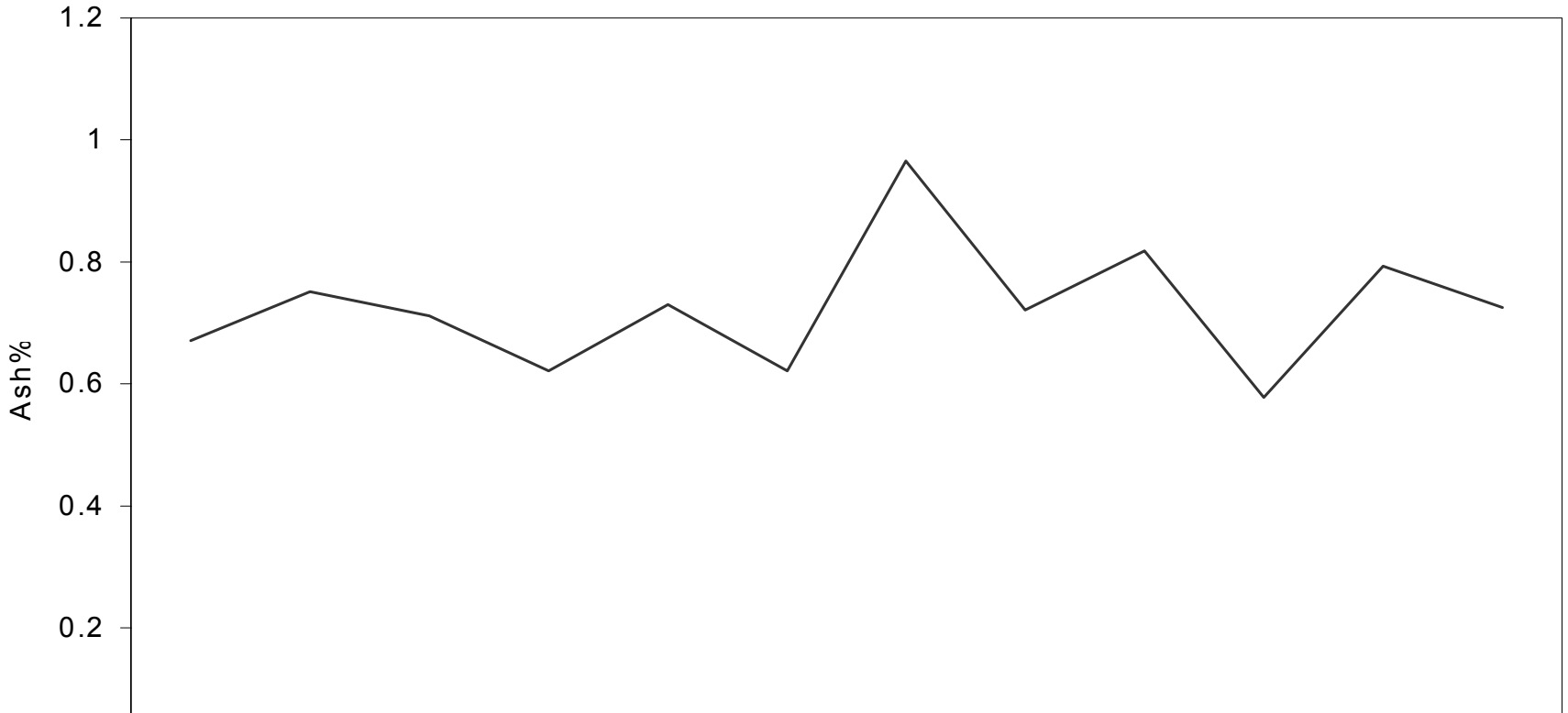


Figure 4.4: The average protien % of crossbred (Nubian X Saanen) goat's milk


6
5
4
3
2
1
0
Lactose%
10
20
30
40
50
60
70
80
90
100
110
120
Days


1.2
1
0.8
0.6
0.4
0.2
Ash%

4-4-5-Total solids content:

The average total solids content was 13.481 + 1.727 % (Table 4.1). The maximum content was 16.31% and the minimum content was 12.323%. The average total solids contents (Fig. 4.7) show gradual decrease in the total solids content until 35 days. Then approximately continued at constant until 110 days, before slight increase in 115 days. The correlation between milk yield and total solids % was negative (– 0.1491) as shown in table 4.2.

4.5 PHYSICO - CHEMICAL PROPERTIES

4.5.1 Freezing point

The average of freezing point was -0.561 ± 0.0365°C, the maximum freezing point was – 0.519 °C and the minimum freezing point was -0.608 °C (Table 4.1). The average freezing point (Fig. 4.8) shows an irregular pattern through out the study period. The correlation between the freezing point and the total solids% was -0.3086; and between lactose and freezing point was – 0.2197 (Table 4.2).

4.5.2 Acidity

The average acidity (lactic acid%) was 0.203± 0.035%, the maximum was 0.256% and the minimum was 0.182% (Table 4.1). Moreover, the acidity (Fig. 4.9) shows a decreasing value during 15 days then followed by an irregular pattern. The increase being more pronounced at the end of the study period (105 days), then it decreases during 110-120 days.

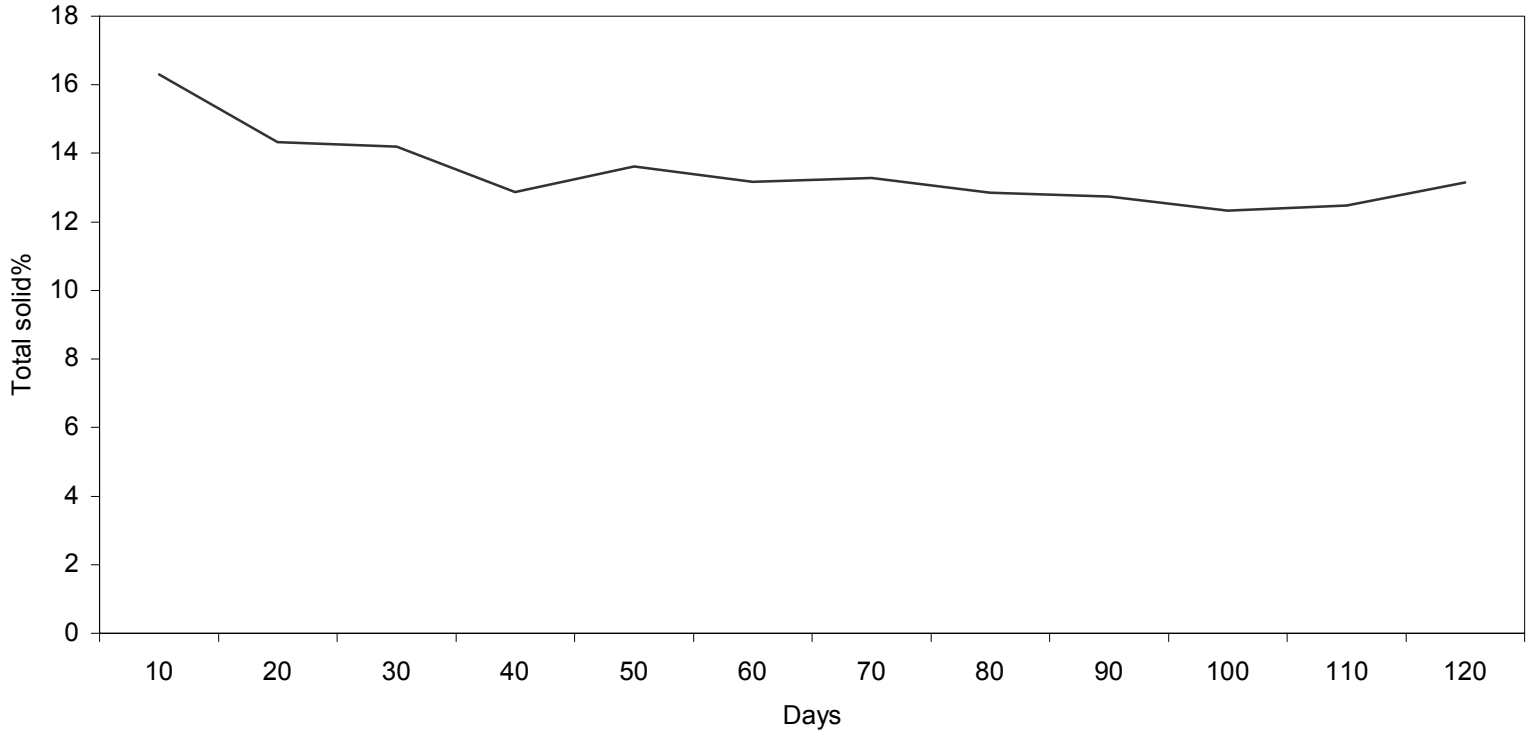


Figure 4.7: The average total solid% of the crossbred (Nubian X Saanen) goat's milk

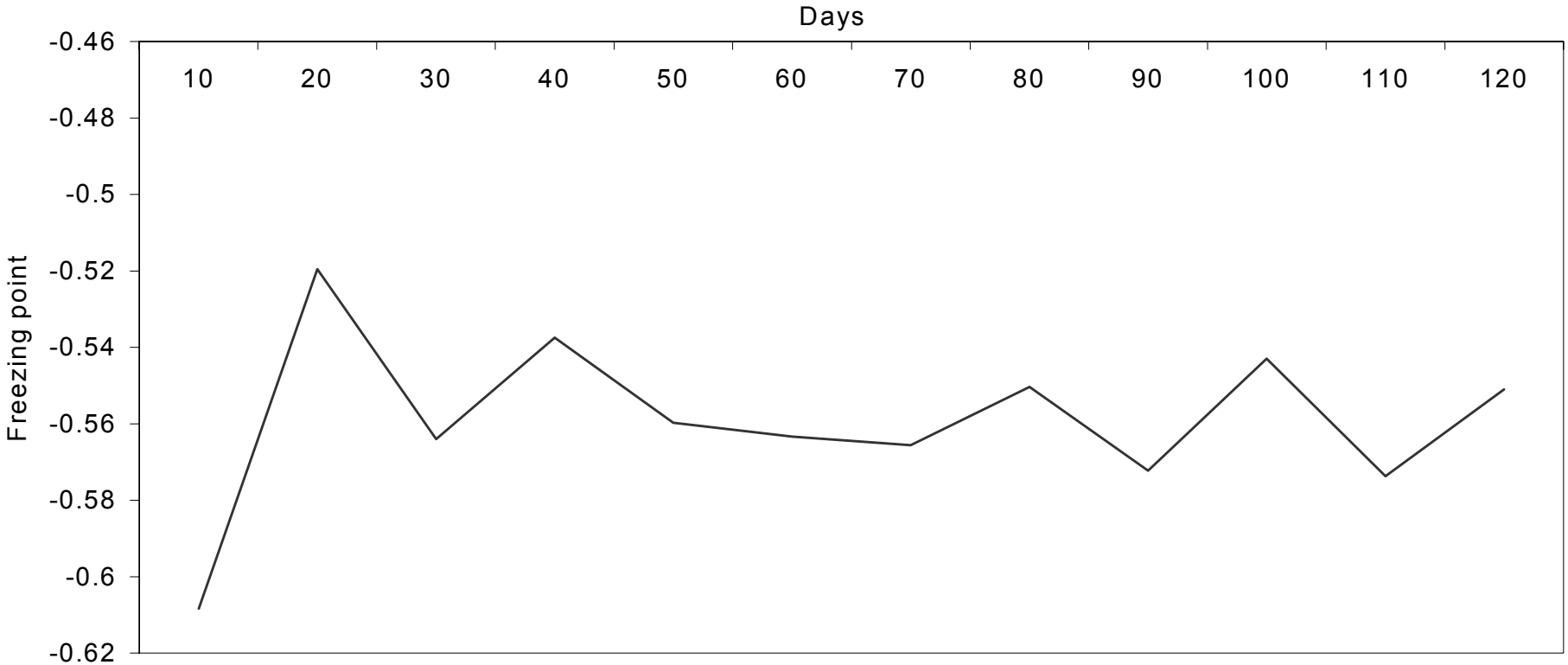
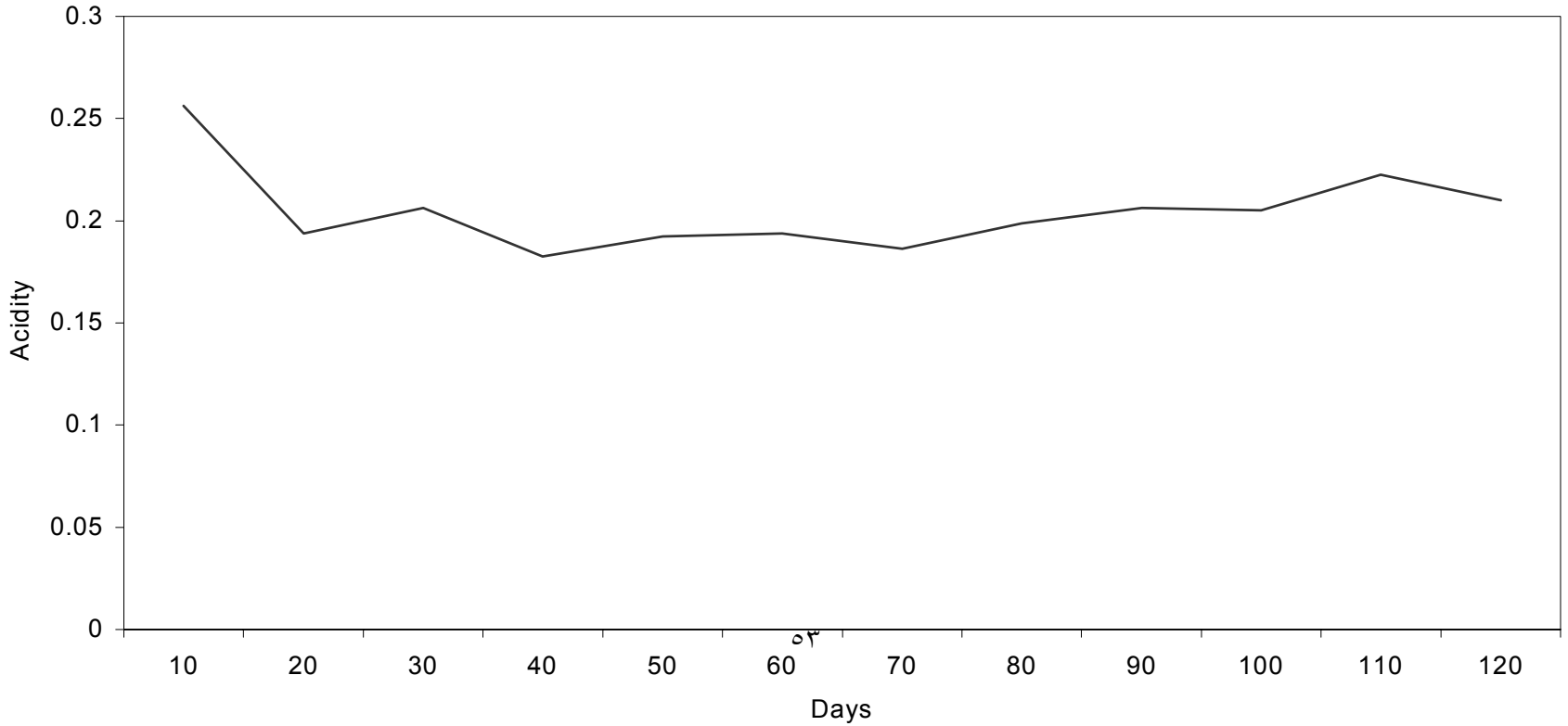


Figure 4.8: The average freezing point degrees of crossbred (Nubian X Saanen) goat's milk


0.3
0.25
0.2
0.15
0.1
0.05
0
Acidity
10
20
30
40
50
60
70
80
90
100
110
120
Days

CHAPTER FIVE

DISCUSSION

The average birth weight of crossbred in the present study (3.56 Kg) was higher than that reported by Kudouda (1985) fgoat, Nubian X Anglo – Nubian and Toggenburg bucks. This might be attributed to the genetic factors (Devendra and Burns, 1983). Similarly, it was higher than that reported by Ibrahim (2000) for crossbred 50% Nubian X 50% Saanen (2.1- 2.9 Kg). This might be attributed to low feed intake of Ibrahim's does and /or due to differences in the dams weights. Whereas the dam's weights in the present study were higher (33.5 Kg) than those reported by Ibrahim (2000) whose does weight averaged 20.8 Kg. Moreover, the differences in parity could be another reason as explained by Castillo *et al* (1976) and Elabid (2002). Whereas the parity of does in the present study was the second and those of Ibrahim were in their first parity.

The persistency of lactation curve (Fig.4-2) for the crossbred goat (Nubian X Saanen); in which the peak milk yield was reached in the second month (5^{th} – 6^{th} week) was in line with the findings of Mackenzie (1980), Gol (1996) Gol and Abdalla (1997) and Ibrahim (2000). However those reports found persistency to occur two weeks later than present study.

The decline in the mean daily milk yield after the peak ness was due to advancement of lactation as reported by Harding (1999). The average daily milk yield of crossbred goat (Nubian X Saanen) found in the present study (1.237 litres) was lower than that reported by Gol (1996). This might be due to low feed intake level in the present study compared to Gol's study. Also it could be due to the milking practices, since the does milked once a day in the present study, while the does were milked twice daily in the study of Gol (1996). This finding supported Harding (1999) who reported that milking twice a day yields

40% more milk than once a day; milking three times a day yields 5 – 20 % over twice a day milking; and milking four times a day may yield an additional 5 – 10.

The average daily milk yield of crossbred goat was lower than those reported by Sommerfield (1993) and Sigwald (1993) for Anglo-Nubian and (Alpine X Saanen) goat, respectively. This might be due to the differences in genetic and environmental factors as reported by Devendra and Burns (1983) and Steele (1996). However the average daily milk yield of crossbred goat (1.237 litres) was more or less similar to that reported by Gol and Abdalla (1997) who found 0.95 Kg for pure Saanen goats, although, the crossbred goats in the present study, were fed less than the pure Saanen of Gol and Abdalla (1997). Similarly, the average daily milk yield was higher than the average daily milk yield reported by Ibrahim (2000) for crossbred Nubian 50% X Saanen 50% (0.51litre). This might be due to the differences in parities, since the does in Ibrahim's experiment were at their first kidding and have low body weight. While, the does in the present study were in the second kidding and have high body weight. This finding supported Frensh (1970), Elnaim (1979), Gall (1980) and Devendra and Burns (1983).

The fat % (4.173%) was higher than those reported by Montigny (1990) for crossbred (Alpine X Saanen), Gol and Abdalla (1997) for pure Saanen under Sudan condition and Chornobai *et al* (1999) for cross Saanen goats in Brazil 31.8gram/Kg, 3.7% and 3.83%, respectively. This might be due to the genetic differences, where the tropics breeds give higher fat% than temperate breed (Devendra and Burns, 1983). Moreover, the average fat % of the crossbred in the present study was more or less similar to the finding of Ibrahim (2000) for Nubian goat, although the fat % in the present study was higher than of Ibrahim (2000) for crossbred (Nubian 50% X Saanen 50%). This might be due to the

low quality of roughages, which was used in Ibrahim's experiment (Sun dried chopped Abu 70). The quality of roughages affect the level of acetate production to maintain milk fat content as explained by Harding (1999).

The average protein (3.66%) was more or less similar to the protein % (3.7%), which reported by Ibrahim (2000) for crossbred (Nubian X Saanen). While, the average protein % in this study was higher than that reported by Gol and Abdalla (1997) for pure Saanen (3.43%). However, the average protein % in the present study was lower than those reported by Elnaim (1979) and Kudouda (1985) for pure Nubian goats (3.42 and 3.46%), respectively. This might be due to genetic factor where the heritability of protein % are 0.50 as stated by Harding (1999). Also, the tendency for milk of tropical breeds appears to be higher in total solids, mainly due to higher fat and protein contents as mentioned by Devendra and Burns (1983).

The average lactose content in the present study (4,914%) was higher than that reported by Kudouda (1985) for Nubian goat (4.31 %), Gol and Abdalla (1997) for pure Saanen (4.41%) and Sung *et al* (1998) for Alpine, Nubian, Saanen and Toggenburg (4.37, 4.16, 4.56 and 4.16%, respectively).

The average ash content (0.733 %) was lower than those reported by Elnaim (1970) and Kudouda (1985), for Sudanese Nubian goat (0.82% and 0.84% respectively). While, it was higher than that reported for Saanen breeds by Gol and Abdalla (1997) who obtained 0.65 %. These differences might be due to differences between breeds as stated by Gol (1996). The average ash content in this study was more or less similar to those reported by Parta *et al* (1998) for Saanen goat (0.74%) and Queirog *et al* (1998) for Anglo-Nubian, Parda Alpine and Saanen crossbred with native breeds in the Brazil.

The average total solids content reported in this study (13.48%) was more or

less similar to those reported by Sung *et al* (1998) for Nubian goat in Tiawan (13.56%) and Queiroga *et al* (1998) for crossbred goats (Anglo-Nubian, Parda Alpine and Saanen crossbred with native breeds in Brazil). The average total solid was higher than the average total solids content reported by Ibrahim (2000) for crossbred (Saanen X Nubian). This due to the highly correlation of the total solids yield with milk yield, where the milk yield of the does in the present study was higher than that of Ibrahim's study. This supported Harding (1999) who reported that the genetic correlation between total solid yield and milk yield revealed + 0.9.

The freezing point in the present study (– 0.561°C) was more or less similar to those reported by Dharmarajan *et al* (1954), Parkash and Jennes (1968) and Prata *et al* (1998) (– 0.545, – 0.580°C and – 0.574 H° respectively).

The acidity (Lactic acid %) in the present study (0.203 %) was more or less similar to those reported by Parkash and Jennes (1968) for goat's milk and Chornobai *et al* (1999) for cross Saanen goat (ranged between 0.1 to 0.26% and 12.96 °D respectively).

CONCLUSION AND RECOMMENDATIONS

Saanen crossbred goat have a good capability for adapting themselves to Sudan local environmental conditions, according to the present study. However, some conditions must be taken in to consideration. In particular the feed intake and energy concentration of the diet during pregnancy and lactating stages, since the feed intake and energy concentration were to be less than the standard level fed for confined production system (Steele, 1996). Saanen crossbred goat have a high milk yield and standard milk compositions compared with others pure breeds, although they have less feed intake, low energy concentration and only once daily milking.

Selection within Nubian breed must go along way to improving the Nubian goat and consequently we can use a crossing process with Saanen goat even brings out a good crossbred. More work is needed to characterize crossbred goat's production potential under local conditions through maximum utilization of available dietary ingredients and the use of appropriate system of husbandry. Moreover, an extra effort is needed to determine the most efficient percentage of crossbred between Nubian and Saanen goat. Twice daily milking is recommended in commercial dairy units with increasing in diet quality and quantity.

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ABSTRACT

The present study was conducted to determine birth weight, body weight, milk yield, milk compositions, freezing point and acidity at second kidding of crossbred (50% Saanen X 50% Nubian) goats.

A total of eight does were selected and milked once daily and weight every ten days. The average birth weight of kids was 3.56 kg and body weight was 33.5kg. Average milk yield was 1.237 liters. Peak daily milk yield of 1.359 liters was reached in 40 – 50 days of lactation. The average of milk constituents were 4.173±1.399% fat, 3.66±0.835% protein, 4.914±0.66% lactose, 0.733±0.245% ash and 13.48±1.727% total solids. The average freezing point was – 0.561±0.0365°C and acidity was 0.203±0.035%. Fat% was the most variable of all constituents which

declined gradually until 105 days. The ash contents and the average freezing point showed irregular patterns through out the study period. Also others constituents were plotted during the study.

The correlation between body weight and yield revealed a positive value (+0.4175). Similarly, the correlation between milk yield and total solids revealed a negative value (–0.1491). The correlation between freezing point and total a solids revealed a negation value (–0.3086), and the correlation between lactose content and freezing point revealed a negative value (–0.2197). While the correlation between body weight and fat% revealed a positive value (+0.1333).

ملخص الدراسة

اجريت هذه الدراسة للتحديد الوزن عند الولادة لهجين الماعز النوبى مـع ماعز السعانين (50%) فى موسم ولادتها الثانى بالاضافه الى تحديد وزن الماعز البالغ وكمية انتاج اللبن ومكوناته ودرجة تجمده ونسبة حموضته.

تم اختيار ثمانية من الماعز الهجين عشوائياً وأجريت لها عملية الحليب مرة واحده يومياً، وتم وزنها كل عشر ايام. وبلغ متوسط وزن المواليـد (السـخلان) عنـد الولادة 3.56% كيلوجرام ومتوسط وزن الماعز البالغة 33.5 كيلو جرام.

وكان متوسط انتاج اللبن للماعز الواحد 1.237 لتر حيث كان اعلى مستوى للانتاج 1.359 لتر ولقد وصل الى هذا المستوى فى الفترة بين ٤٠ – ٥٠يوم من بداية فترة الادرار.

كانت متوسطات مكونات اللبن كما ياتى:-

الدهون 4.173± 1.399 %، البـروتين 3.66±0.835%، سـكر اللـبن لاكتوز4.914±0.66% ،الرماد 0.733±0.245% ، نسبة المواد الصلبة الكلية 13.48±1.727. اما درجة تجمد اللبن وحموضته فقد كانتا 0.561- ±0.0365 درجة مئوية و 0.203±0.035% على التوالى.

نسبة الدهن كانت الاكثر تغيراً مقارنة ببقية مكونات اللبن وكانت تـنخفض بتدرج حتى ١٠٥يوم من الانتاج. وأظهرت كمية الرماد ودرجة التجمد نماذج غير منتظمة خلال فترة الدراسة.

وقد كان معامل الارتباط بين وزن الجسم وإنتـاج اللـبن موجـب القيمـة 0.4175+معامل الارتباط بين انتاج اللبن وكمية المواد الصلبة فى اللبن يسـاوى 0.1491-.

اما معامل الارتباط بين درجة تجمد اللبن ومواده الصلبه فقد كان 0.3086- بينما معامل الارتباط بين كمية اللاكتوز فى اللبن و درجـة تجمـد اللـبن فقـد كـان 0.2197-. غير ان معامل الارتباط بين وزن جسم الماعز وكمية الـدهون فـى اللبن كانت موجبه القيمة 0.1333+.