

Use of Dietary Yeast and its Products in the Feeding Regime of Meat Type Goats

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Abstract

All around the world, sheep and goats play an important role in small scale farming systems. Goat farming is very beneficial from economic point of view. It provides many products but meat and milk are the major products. Goat meat has low level of calorie, fat and cholesterol so it is a healthy substitute to beef and lamb. Moreover goats also use extensively to provide milk for human consumption. It is easier to digest than cow's milk because it has smaller fat globules than cow's milk. In order to support metabolic process all living organisms require essential nutrients, to keep themselves alive so variations in animal diets may improve both the quantity and quality of the final products. In recent years, yeasts are gaining popularity in fattening system as a probiotics.

Since yeast is robust with high viability under a range of environmental conditions and can be culture very easily so yeast cultures are more commonly used as a feed supplements in livestock feeding systems. These cultures have positive impact on microbial population in gastrointestinal tract and they increase the beneficial activities associated with these microorganisms that has indirect impact on animal performance. *Saccharomyces cerevisiae* and *Aspergillusoryza* are the most important yeast products and they are very significant for the manipulation of rumen metabolism.

It is stated by most of the researchers that yeast culture supplementation has positive impact on carcass characteristics, nutrient digestibility, feed intake and the growth performance of the goats in cost effective way but on the other hand some of the scientists do not support that results and they concluded that yeast supplementation in the diet of goats and other ruminants do not have any significant influences on animal performance, carcass characteristics and other features. Step by step, this paper will make the detail evaluation of the use of dietary yeast and its product in the feeding regime of meat type goats, impact of yeast on goat physiognomic features such as growth performance, feed efficiency, digestibility and meat quality.

Keywords: Goat farming; Feeding systems; Yeast products; Yeast culture; Nutrient digestibility; Growth performance; Carcass traits; Meat quality

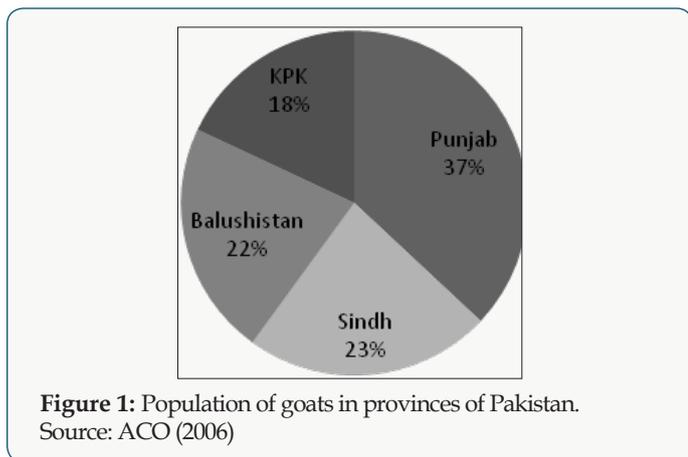
Introduction

Agriculture is the backbone of Pakistan's economy and improvement in this sector is essential for the development of country. This sector contributes 19.82 percent to the Gross Primary Production (GDP), provides employment to 42.3 percent people in the country, provide food to the population and many other products. This sector includes many sub-sectors but main sub-sector is livestock in this sector. About 58.55 percent is the contribution of this sub-sector to agriculture value added and to national GDP its share is 11.8 percent and gross value addition

increased from Rs.778.3 billion to Rs. 801.3 billion. Livestock animals produce milk, meat, wool, bones, fat, skin etc. But milk and meat are the major harvests [1]. About 30-35 M people in the country are associated with livestock related activities and they earn 30-40 percent of their income from this sub-sector [2].

In livestock, Small ruminants (goats and sheep) preferred over large ruminants because of their high productive potential and small size [3].Sheeps and goats are the earliest animals to be domesticated. They can survive on pastures that cannot be used by

other livestock and they can tolerate the period of drought better than any other livestock. Especially, goats are capable to tolerate the water deficiency and even limited amount of fodder is enough or them to survive [4]. After china and India, our country is the third largest goat keeping country in the world [5]. There is total 68.4 million goat population in country and Punjab is the province that has highest goat population as given in Figure 1 [6]. Goats in the country produce 845 million liters of milk and have share to 671 thousand tonnes of mutton produce by small ruminants [1]. More than 25 recognized goat breeds exist in Pakistan [7] along with two wild relatives of goats that are Markhor and Ibex [8].



Goat farming and its products

All around the world, sheeps and goats play an important role in small scale farming systems. Goat farming is very beneficial from economic point of view. It provides many products but meat and milk are the major products. Food is necessary to stay alive. Among the humans religion is the major factor that influences the choices of food. Muslims and Jews are very careful and they only allowed eating halal food such as halal meat and drinks. Halal meat is a meat that obtained from the animals such as goats, sheeps, cattle and chicken that slaughtered under the rules provided by Islam and halal meat do not contain any ingredient from haram animals such as pig etc. [9].

Goat meat is highly nutritious, internationally it is known as lean red meat [10-12]. In most of the developing countries goat meat is very important source of protein [13]. It is one of the staple meats in human diet. It comprises 63 percent of all red meat that consumed worldwide [14]. Goat meat is healthy and better substitute as compared to other red meats. It contains low level of calorie, fat, cholesterol (Table 1) [15] but has high levels of iron and it becomes more popular widely among general population so its demand (as alternative low fat meat) increasing continuously [16]. However, goat meat has necessary fatty acids this is because of the fact that goats deposit greater level of polyunsaturated fatty acids than other ruminants [17,18]. Moreover, goats extensively use for the provision human consumable milk [19]. Pakistan is the fourth largest milk producing country in the world.

Table 1: nutritive comparison of goat meat with other meat.

Cooked/roasted Per 3 oz	Protein (g)	Sat fat (g)	Fat (g)	Cholesterol (mg)	Calories
Goat	23	.79	2.8	63.8	122
Lamb	24	2.9	8.1	78.2	175
Chicken(skinless)	25	1.7	6.3	76.0	162
Beef	25	3.0	7.9	73.1	179
Pork	25	2.9	8.2	73.2	180

Source: USDA (2001)

Approximately 0.7 million tonnes of the milk is produced by goats in Pakistan which is Only 0.2 percent of the total milk produced in the country as shown in Table 2 [20]. Scanty information is available regarding the physiological and chemical facts about the unique quality of goat milk. It contains greater level of short and medium chain fatty acids; these fatty acids are remedial against many diseases and disorders [21]. Goat milk is easier to digest than cow’s milk because it possesses smaller fat globules than cow’s milk [22]. Goat’s milk helps to prevent iron deficiency and bone demineralization because it contains higher vitamins and mineral contents than human milk as shown in Table 3 [23].

Table 2: Amount of milk produced in top ten countries.

Country	Goat milk (million MT)
India	4.0
Bangladesh	2.2
Sudan	1.5
Pakistan	0.7
Spain	0.6
France	0.6
Greece	0.5
Iran	0.4
Somalia	0.4
China	0.3

Source: FAOSTAT (2008)

Table 3: Comparison of vitamins and minerals in human and goat milk.

Composition	Goat milk	Human milk
Vitamin B12	0.64	0.97
Vitamin B6	0.5	0.093
Vitamin A	548	670
Vitamin E	--	2.3
Vitamin Dmg/L	0.6	0.55
Vitamin K	12	2.1
Ascorbic acid	12.6	40
Riboflavin	1.4	0.35
Panthenoic acid	3.0	1.8
Niacin	2.7	1.5

Thiamin	0.5	0.21
Ca mg/L	1304	280
Mg	136	35
K	1996	525
Fe	0.5	0.3
P	1080	140
Na	488	180
Cl	1566	420
Cu	0.23	0.25
Zn	2.9	1.2

Animal hair fibers are more soft and fine than other fibers but they are scarce. Factors such as genetic factors and climatic conditions make it difficult to produce these fibers on large scale. Hair fiber is another very important product of goat farming especially pashmina. All over the world the finest fiber produced by the animals is pashmina that produce in large quantity. It is formed by the hair of Asian native domesticated goat named as *Capra hircus* [24]. China, Mongolia, Iran, Afghanistan, Pakistan, Nepal and India are the chief fiber producing states. Among all these countries china is the major pashmina producer that produce about 70 percent of the total pashmina production. Mostly, pashmina used to make shawls, scarves, gloves, blankets and other fabrics that manufactured manually or are hand spun [25]. It is protenacious in nature which have 18 amino acids containing polyamide polymer and just like wool α -keratins are arranged helically that is why it is chemically similar to wool and mohair fibers [26].

Yeast cultures as a feed supplements in livestock

In order to support metabolic process all living organisms require essential nutrients, to keep themselves alive. In recent years, use of live microorganism and their products as a feed supplements for ruminants is very common. In many types of production systems microbial supplementations have beneficial impact on animal performance. Outcomes of many experiments indicated that the addition of yeast in the diet of goats and cattle is advantageous [27-30].

According to Putnam et al. [29] supplementation of yeast culture in the diet of dairy cows results in the rise in dry matter intake that cause further increase in the milk yield and the amount of milk protein in these animals. Yeast cultures (YC) contain dried yeast cells and these are actually microbial supplements. From many years these cultures use to increase the growth performance of animals. These cultures has positive impact on microbial population in gastrointestinal tract and these cultures increase the beneficial activities associated with these microorganisms that has indirect impact on animal performance [31].

Yeast varieties and its products in small ruminants

In many parts of the world there is a trend to use the yeast products (YP) as a feed additive in the diet of ruminants. Different

yeast products are produced by many companies with variable trade names but a limited number of YP have been evaluated under controlled research studies. *Saccharomyces cerevisiae* and *Aspergillusoryza* are the yeast products and they are very important for the manipulation of rumen metabolism. Agarwal et al. [32] performed an experiment in which they use different strains of *S. cerevisiae* as a microbial feed additive and they reported that *S. cerevisiae* strain NCDC 49 is the best strain because it can tolerate the stressed conditions in gastrointestinal tract of animal. Yeast strains differ in their ability to stimulate the ruminal bacteria. It was reported by Dawson and Hopkins [33] that out of 50 only 7 strains are capable to stimulate the growth of bacteria that digest fiber from the rumen so care should be taken to select *S. cerevisiae* strains for use in yeast culture preparation of ruminants. Baker's yeast strains and Brewer's yeast strains vary in their capabilities to stimulate the critical groups of ruminal microorganisms and former strain has limited capability in this kind of stimulation [34]. According to Zelenak et al. [35] ruminal hemicellulose digestibility increase by the addition of live yeast product Yea-Sacc to the diet when substrate contains 20 percent and 50 percent barely in vitro.

Feeding system and yeast addition

Feed is the essential component in livestock farming and different experiments have been conducted to improve the quality of feeds given to the ruminants. Feed additives has positive influence on digestion rate and leads to the better growth performance, this is because of the fact that feed additives increase gut health of the animals [36]. As probiotics, yeasts are gaining popularity in fattening system. It is robust with high viability under a range of environmental conditions and can be culture very easily [37]. Many researchers proposed that supplementation of yeast culture in the diet up surge feed intake [38,39], nutrient digestibility [40] and the rate of growth [41] in cost effective way [42]. According to some investigators addition of yeast in the feed of meat producing ruminants leads to the variable growth responses that vary from no significant rise in average daily gain to an increase of greater than 20 percent. In this case the average daily gain was 8.7 percent [43].

There are various feeding systems such as high input feeding system, extensive feeding system, intensive feeding system, fodder based feeding system and grain based feeding system, use of yeast as a probiotic in these systems results in variable responses for example Shankpal et al. [44] conducted an experiment in India on Surti goat Kids. In their experiment, these scientists raised their goats under total mixed ration based feeding system with the supplementation of yeast to access its effect on growth performance, digestibility, feed conversion efficiency and feed intake of these kids. Total mixed ration (TMR) based feeding system actually involve mixing of all feedstuffs in an equal ration with respect to their nutritive value so this system supplies an ample amount of nutrition and energy to the animals which enable them to attain maximum performance. These Indian scientists concluded that this inclusion of yeast in feeding system had positive impact on all the

described parameters and also results in 6.66 percent lower feed cost in the experimental group than control group [44].

Furthermore, many scientists conducted an experiments on different animals raised under intensive feeding system for example Kawas et al. conducted an experiment on Pelibuey male lambs in Mexico. These lambs were raised under intensive feeding system with the supplementation of yeast culture and sodium bicarbonate in their finishing diets to check its effect on growth rate and other parameters. At the end of the experiment these scientists concluded that supplementation of yeast in the finishing diet of intensively fed lambs has no significant impact on growth rate, digestibility and rumen pH [45]. Outcomes of this study were similar with the work of some other scientists who concluded that the addition of yeast in the finishing diets of intensively fed bulls has no impact on their growth rate [46-48]. Rearing of the kids under grain based feeding system is helpful to fulfill their nutritional requirements which have positive impact on their growth. However supplementation of diet with yeast enhances these beneficial impacts. According to Nisbet et al. [49] for the fattening ruminants addition of malate and yeast in grain based diets has much more beneficial influences and important for animal health [49].

Effect of yeast on the digestibility and feed intake

Supplementation of yeast in feed improves the digestibility of nutrients and results in higher production of carboxymethyl cellulase activity in rumen [50,51]. Yeast culture leads to the beneficial changes in the digestion by positively influencing the ruminal fermentation. In India it is demonstrated by Kumar et al. [52] that yeast culture has positive impact on feed intake and process of digestion in rumen. On the other hand, some scientists conducted an experiment in Turkey to demonstrate the variations in ruminal fermentation and nutrient degradability of some feedstuffs due to the supplementation of live yeast culture in diet of yearling lambs. In their study they use corn DDGS as a protein source, barley grain as an energy source and wheat straw as roughage and they concluded that live yeast addition in diet has no impact on dry matter (DM) degradability but it reduce the degradability of corn dried distillers grains with soluble (DDSG) in rumen.

Better feed intake has positive impact on animal production [53]. Within 6-8 hrs after meal yeast culture supplementation stimulate the higher degradation of solid feeds and higher intake of dry matter. Dry matter intake is the part of initial rate of fiber digestion. It is reported that yeast culture supplementation increase dry matter intake in some studies [40,54] but not in other studies [55,56]. Dawson et al. [57] demonstrated that yeast culture supplementation has pivotal role in digestion in those animals that maintained at high forage diets In South Brazil, Lima et al. [58] analyze the impact of inactive dry yeast (*S. cerevisiae*) from sugar cane as protein source on dairy goat performance and they reported that dry yeast supplementation in goat's diet cause lower intake of dry matter and organic matter intake as compare to the soybean + dry yeast diet. This is because of the fact that dry yeast

has very fine texture and unusual aroma from sugar cane that cause decrease in the intake of dry matter. Williams [59] confirmed that the quantity of rumen cellulolytic bacteria was amplified by yeast supplementation, exclusively in high concentrate diets.

Effect of yeast addition on growth performance

Many studied demonstrate that diet supplementation with yeast improves the growth performance in finishing lambs [60], calves [61] and bulls [46,47]. According to Haddad et al. [62] yeast supplementation in fattening sheep diet increase the weight gain. In Turkey, Bugdayci et al. [63] conducted an experiment on Saanen male kids and they reported that live yeast supplementation do not influence the live weight gain in goats but some researches do not support this idea [64,65]. However, Mikulec et al. [66] stated that there is no influence of live yeast supplementation on weight and weight gain in lambs. Titi et al. [67] performed an experiment in Jordan and demonstrated that live weight gain and live weight were not affected by the yeast culture supplementation in both awassi lambs and Shami goat kids.

Abou-ward [68] conducted an experiment on lambs and he find out that in average daily gain and dry matter intake significant upsurge occur in lambs as a result of feeding on the ration that contain at least 0.1 percent yeast culture. Rise in dry matter intake was because of the stimulation by cellulolytic bacteria [29,30,54,69]. Some Brazilian investigators reported that supplementation of live yeast never influence lamb performance such a dry matter intake, daily live weight gain, total live weight gain and final live weight [70]. However, it was also observed that the addition of 2.5 to 5g of commercial yeast in the diet of Nubian goats fed sorghum (whole plant) has significant impact on daily live weight gain [71].

Effect of yeast addition on slaughter and carcass traits

Table 4: Carcass characteristics of Awassi lambs and Shami goat kids as influenced by yeast culture (YC) addition in diet.

	Kids		Lambs	
	C	YC	C	YC
Animal in each group Features	6	6	6	6
Fasting weight* (kg)	37.7	38.0	42.3	42.1
LHKSLs** weight (kg)	2.1	2.1	1.5	1.7
HSF***weight (kg)	5.6	5.9	8.1	8.7
Dressing proportion	0.546	0.562	0.526	0.478
Hot carcass weight (kg)	21.1	21.8	23.0	20.8
Empty digestive tract weight (kg)	3.6	3.2	2.1	2.5
Total fat weight**** (kg)	0.40	0.50	0.05	0.10

C: control group (without yeast addition).

YC: treatment group (with yeast culture supplementation).

*Average weight of 6 animals.

**LHKSLs: weight of liver+heart+kidneys+spleen+lungs+sweet-bread.

***HSF: weight of head+skin+feet.

**** fat of heart+kidney+pelvic.

Source: Titi [67].

Particularly with reference to small ruminants scarce work had been published regarding the impact of yeast culture supplementation on carcass characteristics. Titi et al. [67] reported that yeast culture supplementation has no impact on cold dressing proportion and hot carcass weight of Shami goat kids but yeast culture supplementation decrease the cold dressing proportion, overall muscle/bone ratio and hot carcass weight in lambs. Carcass weight reduced in lambs because of the enlargement of the digestive tract due to higher dry matter intake (Table 4). It is demonstrated by kawas et al. [60] that in the lambs that were fed with high grain finishing diet, there is no impact of yeast culture supplementation on dressing proportion and chilled carcass weight of these lambs.

Similarly, Freitas et al. [72] reported that in different breeds of goats inclusion of dry yeast has no influence on hot and cold carcass weight, true carcass yield and carcass compactness index. According to Bugdayci et al. [63] live yeast supplementation in diet has no influence on hot and cold carcass yield in goats as shown in (Table 5) [63]. Similarly, investigators failed to find out any positive impact of yeast culture supplementation on carcass characteristics and composition in bulls or steers [73]. In the same way, some scientists reported that supplementation of *S.cerevisiae* results in the improvement of lamb fattening performance without any significant alteration in carcass traits [74].

Table 5: Impact of yeast supplementation on Saanen male kid's carcass yields and characteristics.

	Dietary treatments			p
	C	S	S+LYS	
Cold carcass yield %	46.53±0.71	43.04±1.21	46.30±1.23	0.060
Cold carcass weight (kg)	12.03±0.72	10.63±1.24	12.16±0.54	0.447
Hot carcass yield %	47.44±0.62	44.28±1.13	46.76±1.31	0.102
Hot carcass weight (kg)	12.26±0.72	10.93±1.26	12.28±0.54	0.512

p<0.05

C: Control group

S: Group served with sucrose added diet

S+LYS: Group served with sucrose and live yeast culture added diet

Source: Bugdayci [63].

Effect of yeast addition on meat quality

Growth rate of goat population is high (3.5 percent per annum) because of preference of goat meat [75]. Meat quality is the standard

term that uses to describe the properties and perceptions of meat. Goat meat is highly nutritious internationally it is known as lean red meat [10-12]. It has course texture, dark red colour and as compare to lamb meat it has different flavor and aroma, characteristically [76]. Sethy et al. [77] observed that redness and tenderness of meat increase but shear force value decrease as a result of addition of 0.3 mg Seas selenium yeast and 100 IU vitamin E in goat diet. Similarly it was proposed by Morrissey et al. [78] that supplementation of diet with selenium yeast results in the rise of α -tocopherol in muscles but decrease the chances of lipid oxidation in muscles.

Likewise, Rufino et al. [79] reported that the addition higher level of inactive dry yeast in the diet of lambs improves the meat quality and carcass characteristics by decreasing the level of intramuscular and subcutaneous fat but by increasing the level of meat crude protein and ash concentration. Dry yeast addition in the diet of different goat breed does not influence the values of cooking loss and shear force value [72]. Some investigators concluded that quality of meat improved and shelf life extend as a result of supplementation of diet with Selenium yeast and vitamin E because it enhanced antioxidant status in the muscle [80]. Effect of yeast supplementation on lamb meat quality has also been demonstrated by Titi et al. [67] who concluded that the addition of live cultures of *S.cerevisiae* yeast in diet leads to the significant change in the chemical composition of meat.

Conclusion

All the yeast culture supplementation strategies are not identical in their efficiency because the influences of yeast culture supplementations on animal efficiency are strain dependent so the results of supplementations may vary considerably. However, it is concluded that the addition of yeast in the diet of goats and other ruminants is beneficial. Yeast culture supplementation is very convenient strategy that positively modifies the microbial actions, digestive tasks in rumen, meat quality and fattening performance in goats but still it is prerequisite to conduct more experiments under different feeding circumstances and in extended fattening episodes to clarify the beneficial influences of yeast addition in the diet of goats.

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