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Multivariate Analysis of Socio - Economic Variables of Dairy Farmers Towards Rearing Crossbred Cows in Banaskantha District of Gujarat

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Abstract

Dairy farming in India is one of the most important means of providing livelihood and nutritional security to vast rural population. Though Gujarat is one of the leading states in dairy sector it has inherent constraints of low yielding non-descript cattle population along with scarcity of balanced resources of feed and fodder. No previous attempts had been made to study the attitude of dairy farmers towards rearing of Crossbred cows and relationship analysis between attitude and dairy farmer's characteristics. So taking these considerations, the present study was conducted on the topic 'Multivariate Analysis of Attitude of Dairy Farmers towards Rearing Crossbred Cows in Banaskantha District of Gujarat'. Total 120 dairy farmers were selected as respondents by using multistage random sampling from 12 villages, those who were having at least one Crossbred cow. Data were collected by personal interview method using a well structured interview schedule and collected data were analysed using appropriate statistical tools. The personal, socio-economic, communicational and socio-psychological profile of dairy farmers revealed that most of the respondents belonged to age group of 36 to 50 years and educated up to primary school level, had medium family size and low social participation. Majority were in a no training received group, followed by medium level of training received by farmers, have high experience in dairying and medium level of institutional infrastructure accessibility.

Most of farmers were having semi medium land holding, large herd size, high total annual income and majority of respondents were engaged in dairy farming occupation. Total milk production and sale were found at high level. Majority of the respondents were having high mass media exposure and medium extension contact. Most of the respondents were having high economic motivation and medium risk orientation. Majority of the respondents had neutral attitude towards rearing Crossbred cows, followed by favourable and unfavourable attitude. The variables namely education, social participation, training received, institutional infrastructure accessibility, occupation, herd size, milk sale, total annual income, extension contact and economic motivation had shown positive and highly significant relationship with the attitude of dairy farmers. While age showed the negative and significant relationship with attitude of dairy farmers towards rearing Crossbred cows. Repeat breeding problems in Crossbred cows due to faulty A.I. techniques and non availability of expert services to treat repeat breeders were the most important constraint experienced by dairy farmers. The study highlighted the need of organizing more number of training related with Crossbred cows rearing practices and active participation by dairy farmers which would bring a significant change in the attitude of dairy farmers towards Crossbred cows.

Key words: Repeat Breeding; Crossbreeding; A.I.Technique; Attitude; Dairy Farmers.

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Introduction

India has a major share of the global population of the livestock with rich and vast genetic resources. Livestock industry plays an important role in national economy and socio-economic development of our country. Out of this industry, dairying is a valuable treasure and source of poverty eradication, employment generation and an instrument of social change in rural India. Dairy farming in India is one of the most important means of providing livelihood and nutritional security to vast rural population. India, with its sizeable dairy sector is growing rapidly and moving towards modernization, resulting in prosperity in the years to come. During the last few decades of dairy development, thanks to Operation Flood Programme. India has emerged as the largest milk producing country in the World with 133 million tonnes and during 2012-13. The milk production of Gujarat state is 9.82 million tonnes and rank 4th in the country. Banaskantha district produce milk 32 lakh liters per day (www.dahd.nic.in/annual report/socio economic review 2011-12, Gujarat state). Although per capita availability of milk has increased from 112 grams per day in 1968-69 to 276 grams per day in 2010-11, yet it is still low as compared to requirement of 290 grams per day (Indian Dairy Man, March, 2012). In the state per capita availability of milk is 435 gm/day during 2010-11.

India is home to the world's largest dairy herd, but the country still faces a production shortfall due to massive demand from growing population and also low productivity of Indian cows. In spite of India's position as highest producer of milk, productivity per animal is very poor. It is only about 987 kg / lactation as against world average of 2,038 kg / lactation. This low productivity is due to the gradual genetic deterioration and rises in the population of non-descript cows (80 per cent) and buffaloes (50 per cent) (NDDB, 2010-11).

Cross breeding, scientifically speaking is the mating of animals belonging to different breeds. Cross breeding in local cattle with exotic dairy breeds was introduced in the country to improve their genetic potential so as to produce cows having characteristics, like higher lactation yield, early maturity, lower age at first calving and shorter dry period.

Use of modern inputs and adoption of new agricultural technology are undoubtedly more important in increasing farm productivity. Numerous improved technologies have been developed in the recent past in the field of Animal Husbandry sector. In spite of intensive efforts by the scientists and extension workers these technologies have failed to make inroads among the livestock farmers. Various reasons have been put forth for this debacle, which includes lack of interest at the level of livestock farmers, lack of awareness, lack of technical knowledge, lack of technical facilities, lack of resources, social and economical constraints, lack of infrastructural facilities, low literacy rate, poor adaptability and suitability of technologies etc. That's why detail understanding of the changing rural scenario, preferences, needs and problems associated with rural life, improved animal husbandry and veterinary practices are must for ensuring growth and development of livestock sector. Thus, there is a strong need to overcome these constraints so that our livestock farmers in these regions can better adopt the improved practices and make their dairy more profitable one for their socio-economic development. It is necessary to motivate farmers to adopt modern technologies instead of traditional farming. This is possible only by imparting continuous training and education with financial assistance in kind.

Even though studies carried out in different disciplines showed a vast difference in performance of Crossbred and indigenous cattle, not a single study had been undertaken in extension perspective like attitude of dairy farmers towards rearing of Crossbred cows, relationship analysis between attitude and dairy farmers characteristics and constraints experienced during rearing Crossbred cows under field condition, which is very much essential for the successful implementation of the various cross breeding programmes of the state.

The productivity potential of Crossbred cattle in Gujarat is still to be realized. With this perspective an empirical study was carried on "Multivariate Analysis of Attitude of Dairy Farmers towards Rearing Crossbred Cows in Banaskantha District of Gujarat" To find out personal, socio-economic, communicational and socio-psychological characteristics of the dairy farmers, to measure the attitude of dairy farmers towards rearing Crossbred cows, to determine the relationship between attitude and characteristics of dairy farmers, to identify the constraints experienced by dairy farmers in rearing of Crossbred cows and to seek the suggestion from Crossbred owners to overcome constraints-problems.

Materials and Methods

Research methodology is considered to be a 'blue-print' of the research architect. The term

methodology, in broad sense, refers to the process, principles and procedures by which we approach our problem and seek its answer. In social science, the term "methodology" is applied to know about how one carries out the process of research. In this chapter, an attempt has been made to explain the various methods and procedures followed to investigate the problem.

Area of the Study

For the present study, Banaskantha District was purposively selected .Animal Husbandry is the most important subsidiary activity of farming community of the district. Also Banaskantha is the leading district in milk production in the state and having highest cattle and buffalo population in the state. The district is considered as the milk bowl of the state. Through co- operative and state animal husbandry department, the assured veterinary services and milk marketing facilities are available to the dairy farmers.The district is having one of the four Agricultural Universities of Gujarat state, i.e., Sardarkrushinagar Dantiwada Agricultural University, where the College of Veterinary Science and Animal Husbandry, the Dairy Science College and Polytechnic for Diploma in Veterinary Science & A. H. are located. Familiarity of the investigator with respect to the area, people and officials; which made possible for the investigator to elicit the information from the respondents within the limited time.

Background information of the Banaskantha District

The district is located in the North-East of Gujarat and is presumably named after the West Banas river which runs through the valley between Mount Abu and Aravalli range, entering into the plains of Gujarat in this region and flowing towards the Rann of Kutch. Banaskantha is one among the thirty three districts of the Gujarat state of India. The administrative headquarters of the district is at Palanpur which is also its largest city.

In Gujarat, district of Banaskantha lies in the North-East part. To its North is Rajasthan state and to its South lies the Patan and Mehsana district. Sabarkantha district flanks it in the East and district of Kutch district is in the West. It is located approximately in between 71°25' east longitudes and 23°45' north latitude. As of 2011 Indian census, the Banaskantha district has a population of 3,116,045. The total geographical area is 10,751 Km^2. The district ranks first in the state in the production of vegetables contributing nearly 17.67% to the total vegetable production of Gujarat. It is the largest producer of potatoes in the state. Bajari, Maize, Tobacco, Castor oil, Jowar, Psyllium are the other major crops of the district. It is also one of the leading producers of Isabgul (Psyllium husk) in the country. It is also the 3rd largest producer of oil seeds in the state after Junagadh district and Jamnagar district. Banaskantha District Central Co-operative Bank is one of the most important banks of Gujarat.

Research Design

The study was confined to "ex-post-facto" research design as the independent variables had already operated in study area. Kerlinger (1976) stated that "ex-post-facto" research design is worthy to apply when the independent variables have already acted upon.

Sampling Techniques

Selection of taluka and villages

Out of twelve taluka of Banaskantha district, three taluka like Palanpur, Deesa and Vadgam were selected randomly . The selected taluka are shown in fig.3.1 from each selected taluka, four villages were selected by random sampling, thus making total of twelve villages.

Table: List of selected taluka and villages

Taluka	Villages		
Palanpur	Gadh	Kushkal	Mota
Deesa	Tetoda	Serpura	Davas
Vadgam	Vadgam	Kodaram	Mumanvaas

Selection of the respondents

A list of respondents / farmers having atleast one Crossbred cow was prepared taking help of local villagers and panchayat leaders and the respondents who were having atleast one Crossbred cow were selected randomly. From each village ten respondents were selected making a total of 120 (ten farmers from each village) respondents.

Selection of Variables

For any study undertaken in social research, it is customary to precisely mention the variables used for the study with their working concepts and measurement procedures. After the collection of review of literature and consultation with the experts, relevant variables were selected for the study. Table depicts the variables and their respective measurement at a glance.

◆ **Independent variables**

1. Socio-economic variables
   - i. Land holding
   - ii. Occupation
   - iii. Total annual income
   - iv. Herd size
   - v. Total milk production
   - vi. Milk sale

Variables along with techniques used for their measurement

Sr. No.	Selected variables	Measurements
1.	Independent variables	
	Socio-economic variables	
2	Land holding	Actual land available with farmers Classification as reported by G.O.I (2001)
3	Occupation	Direct questioning - Interview Schedule was developed
4	Total annual income	Actual income of the respondent- Interview Schedule was developed
5	Herd size	Number of animals with farmers- Interview Schedule was developed
6	Total milk production	Actual amount of milk produced at farmers home or farm- Interview Schedule was developed
7	Milk sale	Actual amount of milk sold- Interview Schedule was developed

Tools for The Study

Keeping in view the objectives of the study, a structured interview schedule was prepared, While formulating questions for the schedule, the investigator sought the help and technical guidance from available literature, teaching staff of the Department of Extension Education, the senior faculty of College of Veterinary Science and A.H., Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar and State Government Veterinary Officer of Animal Husbandry department as well as Veterinarians of co-operative dairy. The respondents were interviewed personally, with the help of structured interview schedule.

Pre-Testing of The Interview Schedule

In order to test the administrability of each question and statement and to remove ambiguity in measuring instruments if any, pre-testing was carried out with twenty non sample dairy farmers. The respondents were informed about the importance and purpose of the study. On the basis of the responses received and the problems encountered during interview, necessary changes were made and the final schedule was prepared, which was translated into Gujarati for formal data collection.

Method of Data Collection

The investigator personally interviewed the farmers selected for the study. The objective of collection of information was made cleared to the farmers to build up their confidence and faith. The respondents were contacted during their leisure time either at their farm or home.

Measurement of Variables

Measurement of independent variables

Socio-economic variables

Land holding

It implies the area of cultivated land in which the respondents possessed. It was measured by direct questioning. The respondents were categorized into landless, marginal, small, semi-medium, medium and large group as per Government of India (2001):

a) Landless	:	0 hectare
b) Marginal	:	<1 hectare
c) Small	:	1-2 hectare
d) Semi-medium	:	2-4 hectare
e) Medium	:	4-10 hectare
f) Large	:	>10 hectare

Occupation

Occupation refers to means through which a person earns livelihood for his family. Operationally, it was defined in terms of the farmer's source of earning viz., Agriculture, Dairying, Labour, Services and Business. Respondents were asked to indicate their main and subsidiary occupation separately. Frequency distribution was used to classify the respondents into the following occupational categories

- Agriculture
- Dairying
- Agriculture + Service
- Service
- Business
- As a labourer

Total annual income

It refers to the total annual earnings of the respondents in rupees accrued from dairying as well as from other sources. It was measured with the help of schedule and respondents were categorized by using mean and standard deviation.

Category	:	**Annual Income (Rs.)**
Low	:	Less than (Mean – S.D.)
Medium	:	(Mean – S.D.) to (Mean + S.D.)
High	:	Above (Mean + S.D.)

Herd size

In present study, herd size refers to the total number of bovines of different age group, i.e. cattle (Crossbred and local) and buffalo owned by the respondent at the time of investigation. It was ascertained by direct questioning/measured with the help of a schedule and then the respondents were categorized into small, medium and large herd size groups by using the mean and standard deviation.

Category		**No. of animals**
Small	:	Less than (Mean – S.D.)
Medium	:	(Mean – S.D.) to (Mean + S.D.)
Large	:	Above (Mean + S.D.)

Total milk production

It refers to the average total quantity of milk in liters per day produced by household on previous day of data collection. It was measured with the help of schedule or the information was collected by directly asking to the respondent.

Respondents were categorized into low, medium and large producer's categories on the basis of mean and standard deviation.

Category	:	**Milk production (liters/day)**
Small producer	:	Less than (Mean – S.D.)
Medium	:	(Mean – S.D.) to (Mean + S.D.)
Large producer	:	Above (Mean + S.D.)

Milk sale

It refers to the quantity of milk sold by the respondents out of total milk produced per day. The information was collected by directly asking to the respondent and then categorized by using mean and standard deviation.

Category	**:**	**Amount (litres/day)**
Low selling group	**:**	Less than (Mean – S.D.)
Medium selling group	**:**	(Mean – S.D.) to (Mean + S.D.)
Large selling group	**:**	Above (Mean + S.D.)

Statistical Framework Used For Analysis of The Data

The data collected from the respondents were classified, scored, compiled, and tabulated in the light of objectives of the study/statementwise with respect to each of the variable contained in the schedule. Master sheets were prepared with pooled scores for respective objectives and then subjected to various statistical tools to draw the logical conclusions.

Based on the nature of the study, various statistical tools were used particularly relevant to full fill the specific objectives of the present study. These were frequency, percentage, mean, standard deviation, correlation, regression and path analysis.

The tabulated data were analyzed statistically with the help of following statistical tools and methods:

Percentage

The percentage value was calculated to make simple comparisons. Percentage value was calculated by dividing the frequency in the particular cell by number of respondents and multiplying it by 100.

Frequency

This was used to find out the number of respondents in each cell.

Mean scores

The arithmetic average of the set of the data had to be often computed during the analysis of data. This measure was used to see the central tendency of the data. The mean score of a series of data was equal to the sum of the individual measures divided by the total number of respondents.

The mean was used for the categorization of the respondents and it was calculated by using following formula

$$X = \frac{\Sigma X_i}{n}$$

Where,

X = General mean

Xi = Observed value

n = Total number of respondents

Standard deviation

The standard deviation is defined as the square root of the mean of the squared deviations of individual values from their means. It indicates a sort of group standard spread of values around their mean.

Standard deviation was used for classification of the respondents in the different categories

$$SD = \frac{\Sigma (Xi - X)^2}{n - 1}$$

Where,

S.D. = Standard deviation

Xi = Observed value

X = General mean

n = Total number of respondents

Co-efficient of correlation

Pearson's co-efficient of correlation co-efficient was used to calculate 'r' value, which facilitated the relationship between dependent and independent variables.

$$r = \frac{\Sigma xy}{\text{----------}}$$

Where,

r = co-efficient of correlation

X = Independent variable

Y = Dependent variable

Σxy = Sum of product of the deviation of X and Y from their mean

Σx^2 = Sum of square of the deviation of X from their mean

Σy^2 = Sum of square of the deviation of Y from their mean

Hypothesis: Null hypothesis: Population correlation co-efficient is 0

Alternative hypothesis: Population correlation co-efficient is not 0

Multiple regression analysis

Regression analysis provides an estimate of values of dependent variable from values of independent variables

The prediction equation used as:

$$Y = a + \sum_{i=1}^{n} b_i x_i$$

Where,

Y = Predicted dependent variable

a = Intercept or constant

b_i = Regression coefficient between i^{th} independent variable with

dependent variable where i = 1, 2 … k

$x_1 \ldots x_k$ = Independent variable

Hypothesis

Null hypothesis: Estimated multiple linear equation is not significant

Alternative hypothesis: Estimated multiple linear equation is significant

Path analysis

This multivariate linear path model was adopted to explain direct and indirect effects of independent variables on dependent variables. The postulated model is:

$$ryx_i = pyx_i + \sum_{i=1}^{n} rx_i x_j \times pyx_j$$

Where,

ryx_i = Correlation co-efficient of X_i with Y

pyx_i = Direct effect and each of the other term in the equation is an indirect effect

I = 1, 2, 3, … …, n

n = Indirect effect of independent variable to dependent

$\Sigma rx_i x_j \times pyx_j$ = via another independent variable

$i = 1$

Results and Discussion

- *To find out socio-economic characteristics of dairy farmers.*

The results derived on these aforestated characteristic of the respondents under present study highlight their personal traits. Information on these traits are useful as traits were assumed to correlate with attitude and also helps in estimation of dependent variable (attitude) of the respondents towards rearing Crossbred cows. The data collected were analyzed and results are discussed under the following subheads:

- *Family size*

Table clearly indicated that majority (80.00 per cent) of the respondents had medium family size of 5 to 7 members whereas, 13.33 per cent and 6.67 per cent of respondents belonged to small (<5) and large family size (>7), respectively.

Personal profile of dairy farmers **n=120**

Sr. No.	Variables	Mean	Category	Frequency	Percentage
1.	Age (years)	42.71	Young (up to 35)	30	25.00
			Middle (36-50)	64	53.33
			Old (>50)	26	21.67
2.	Education	1.88	Illiterate(0)	26	21.67
			PrimarySchool(1)	34	28.33
			Middle school(2)	22	18.33
			High School(3)	18	15.00
			HigherSecondary(4)	06	05.00
			Graduation & Above(5)	14	11.67
3.	Family size	4.79	Small (<5)	16	13.33
			Medium (5-7)	96	80.00
			Large (>7)	08	06.67
4.	Social participation	2.38	Low (<3)	99	82.5
			Medium (3-5)	18	15.00
			High (>5)	03	02.50
5.	Training received (no. of times)	0.075	No Training (0)	42	35.00
			Low (1)	30	25.00
			Medium (2)	41	34.16
			High (3 or more)	07	05.84
6.	Institutional infrastructure accessibility	4.12	Low (<2.65)	22	18.33
			Medium (2.65-5.577)	62	51.67
			High (>5.57)	36	30.00

The present finding get support from the finding reported by Sah (2005), Babu (2007), Raut (2010) and Alam (2012).

- *Social participation*

Table clearly indicated that majority (82.50 per cent) of the respondents had low social participation, followed by medium level (15.00 per cent) of social participation. It also states that 2.50 per cent of respondents had high level of social participation.

This finding is similar to the finding reported by Temkar (2000), Gour (2002) and Ashwar (2005).

- *Training received*

It is evidently clear from the figures in table that 35.00 per cent of the respondents had not received any training. It was followed by respondents who had received training two times (34.16 per cent). It was followed by respondents who had received training only once (25.00 per cent) and three or more times training (05.84 per cent).

This finding is similar to the finding reported by Baindha (2011).

- *Institutional infrastructure accessibility*

Table clearly indicates that 51.67 per cent of respondents had medium level of Institutional infrastructure accessibility, followed by high (30.00 per cent) and low (18.33 per cent). It means dairy farmers having medium Institutional infrastructure accessibility should be brought maximum under umbrella of Crossbred cows rearing programme.

This finding is similar to the finding reported by Kannan (2002), and Prakash (2005).

- *Experience in dairying*

Table clearly indicated that majority (57.50 per cent) of the respondents had high level of experience in dairying ranging from 15 years to more than 15 years, followed by medium (40.83 per cent) and low (1.67 per cent) level of experience in dairying.

- *Socio-economic profile of dairy farmers*

To study the socio-economic profile of the respondents the related variables were analyzed and results are presented in table , which are subjectively described in the following sub-heads:

- *Land holding*

Table showed that 29.16 per cent of the respondents were possessed 2-4 hector of land, followed by up to 4-10 hector (28.33 per cent), whereas 13.35 per cent of respondents possessed less than one hector of land and 3.33 per cent of respondents possessed more than ten hector of land and rest of 02.50 per cent of respondents were landless.

The present finding gets support from the finding reported by Patel (2005) and Prajapati (2008).

- *Occupation*

Table showed that 35.00 per cent of respondents had dairying as their occupation, followed by 31.67 per cent of the respondents having agriculture as their occupation. It was followed by 14.16 per cent of respondents having agriculture with service and 7.50 per cent of respondents had labour as their occupation. Whereas, 6.67 per cent of respondents having their own business followed by 5.00 per cent had service as their occupation.

- *Total annual income*

It could be observed from table that more than half of the respondents (58.34 per cent) were under high income group (Rs. > 2, 13,000), followed by (30.83 per cent) respondents under medium income and (10.83 per cent) respondents under low income group.

The present finding gets support from the finding reported by Patel (2006).

- *Herd size*

Table clearly enunciated that majority (54.16 per cent) of respondent's possessed more than 8 animals. While 34.16 per cent of respondents possessed 4- 8 animals, followed by 11.68 per cent of respondents having less than 4 animals.

The finding is in line with the findings reported by Lokhande (2009) and Tak (2010).

- *Total milk production*

Table indicated that more than half of the respondents (56.67per cent) were in the large producer category (> 18 litres/day/household) of milk production, whereas 25.00 per cent and 18.33 per cent of dairy farmers were in medium and small category of milk production. The overall average milk production per day was 38.95 litres/day/household.

- *Milk sale*

Table indicated that majority of the respondents (60.00per cent) were in the large category (>12 litres/day/household) of milk sale which was followed by 23.33 per cent and 16.67 per cent of respondents in the medium and low category of milk sale groups. The average milk sale per day was 35.79 litres/day/household.

This finding is similar to the finding reported by Gaikwad (2010). The data shown in table clearly revealed the suggestions expressed by dairy farmers

Socio-economic profile of dairy farmers **n=120**

Sr. No.	Variables	Mean	Category	Frequency	Percentage
1.	Land holding (hectare)	3.54	Landless (0)	03	02.50
			Marginal (<1)	16	13.35
			Small (1-2)	28	23.33
			Semi medium (2-4)	35	29.16
			Medium (4-10)	34	28.33
			Large (>10)	04	03.33
2.	Occupation	3.025	Agriculture	38	31.67
			Dairying	42	35.00
			Agriculture+ Service	17	14.16
			Service	06	05.00
			Business	08	06.67
			Labour	09	07.50
3.	Total income (Rupees)	2,99, 653	Low (<93,000)	13	10.83
			Medium (93,000-2,13,000)	37	30.83
			High (>2,13,000)	70	58.34
4.	Herd size (no. of animals)	10.77	Small (<4)	14	11.68
			Medium (4-8)	41	34.16
			Large (>8)	65	54.16
5.	Total milk production (litres/day)	38.95	Small (<10)	22	18.33
			Medium (10-18)	30	25.00
			Large (>18)	68	56.67
6.	Milk sale (litres/day/household)	35.79	Low (<7)	20	16.67
			Medium (7-12)	28	23.33
			Large (>12)	72	60.00

of Banaskantha district for overcoming the constraints in rearing Crossbred cows. Their suggestions were: Expert services should be made readily available at village level to treat the repeat breeder was ranked first suggestion. These was followed by suggestion of lay insemination of village milk co- operative societies and livestock inspectors should be given extensive training to improve knowledge and skill for better result of A.I. and step should be taken to come down concentrate and fodder price was second ranked followed by veterinary services should be made available at village level and that to at affordable price was third ranked followed by veterinary health care and fertility improvement camp should be organized time to time for poor productive animals, dairy farmers should be given training on the aspects of mastitis control, importance timely vaccination, deworming and management and health aspects, provision for timely and easy availability of sufficient loan for purchase of animals, step should be taken to come down concentrate and fodder price and inputs at affordable intern.

Suggestion expressed by dairy farmers

The important suggestion of Crossbred owners to overcome the constraints in rearing of Crossbred cows

Sr. No.	Suggestions of dairy farmers	Number of respondents	Percent	Rank
1	Expert services should be made readily available at village level to treat the repeat breeder.	118	98.33	I
2	Lay insemination of village milk co- operative societies and livestock inspectors should be given extensive training to improve knowledge and skill for better result of A.I.	113	94.16	II
3	Step should be taken to come down concentrate and fodder price.	113	94.16	II
4	Veterinary services should be made available at village level and that to at affordable price.	104	86.66	III
5	Veterinary health care and fertility improvement camp should be organized time to time for poor productive animals.	101	84.16	IV
6	Dairy farmers should be given training on the aspects of mastitis control, importance timely vaccination, deworming and management and health aspects.	101	84.16	V
7	Provision for timely and easy availability of sufficient loan for purchase of animals and inputs at affordable interest rate is to be there.	93	77.50	VI
8	Mastitis control measures should be there at every village level through co-operative or ICDP.	87	72.50	VII
9	Provision of incentive for production of hygienic milk should be there.	81	67.50	VIII
10	Remunerative price for milk and milk products should be provided.	77	64.16	IX
11	Fodder storage depot should be there from government side and at the time of drought dairy farmers should be given fodder on rationing basis for their animals.	73	60.83	X

Conclusion

Lastly we could conclude that any activity whether of a single individual or a group, whether in private or public sector, whether concerning social, political, religious or economic matters is never without some sort of ordinary, moderate or acute constraints. If one considers dispassionately, even the most successful act is seldom without the existence of constraints, hurdles, roadblocks of difficulties. It could at the best be said, in this context, that where we want our activity really a great successful one, whatsoever possible barriers/hurdles/problems/impediment there, be envisioned in advance and appropriate actions should be taken to eliminate or minimize their influence. It is not considered enough to merely cite the constraints, but the real purpose is to bring about consciousness and realizations for dealing with them based on further knowledge. Just as forewarned is four- armed, the knowledge about constraints can make the implementations and planners of the programme, wise and boldly confident to minimize, if not completely eliminate, these constraints.

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Effect of Feeding Probiotic, Prebiotic and Their Combination on Growth Performance of Broilers

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Abstract

One hundred eighty (180) unsexed day old 'Cobb400' broiler chicks of same hatch were weighed individually and distributed randomly into four treatment groups, consisting 45 chicks in each treatment group. Each group was further divided into three replicates of 15 birds each. The four treatments were *viz*. – control - without supplementation of probiotic or prebiotic (T_1), Prebiotic supplementation @ 500 g/tonne of feed (T_2), Probiotic supplementation @ 100 g/tonne of feed (T_3), Synbiotic supplementation in which probiotic @ 100 g/tonne of feed and prebiotic @ 500 g/tonne of feed (T_4). The chicks were reared in deep litter system and standard farm managemental practices were followed.

The body weight, body weight gain, feed consumption of broiler feeding were studied. The dietary supplementation of probiotic and synbiotic had better ($P<0.05$) body weight as compared to control and prebiotic fed birds.

Keywords: Prebiotic; Probiotic; Feed Consumption; Body Weight Gain; Supplementation.

Introduction

Poultry farming is one of the fastest growing segment of agro livestock industry in India. The potential of poultry farming as a viable industry is reflected in the amazing growth of the agriculture sector during last three decades and the same has not been recorded in any other agriculture sector.

Poultry occupies an important place in Indian economy contributing more than Rs. 11,000 crores to the national GDP. India ranks 3rd and 5th with respect to production of egg and meat respectively in the world (BAHS,2010). The per capita availability of poultry meat is 2.15 kg/annum which is very less as against the recommendation of 11 kg meat/annum given by NIN (National Institute of Nutrition) (Prabhakaran, 2012). Now a day, the efficiency of poultry to convert the feed into meat plays a key role in economics of broiler industry. Therefore, it is highly essential to improve feed efficiency of poultry to produce meat economically and also food safety is more seriously considered than before. On the other hand, economy of food production is also a factor that cannot be ignored. A huge amount of antibiotics have been used to control diseases and improve performances in livestock. However, due to growing concerns about antibiotic resistance and the potential for a ban for antibiotic growth promoters in many countries in the world, there is an increasing interest in finding alternatives to antibiotics in poultry production.

Despite the spectacular growth in broiler production, the per capita consumption of broiler

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meat in India is nearly 1000 g/year (Vaidya, 2003) which is much below the per capita ICMR recommendation of 9 kg and also against 25 Kg per head per annum in developed countries. Though, an expected growth is apparent in poultry industry, a severe crisis is seen due to rising feed cost, emergence of new diseases like bird flu and lowered meat and egg prices. Presently the margin between profit and loss in the poultry industry is very nominal and profit in the poultry farming is possible only when the farm achieves maximum production with minimum inputs.

Prebiotics are non -digestive feed ingredients that beneficially affect the host by selectively stimulating the growth or activity of one or a limited number of bacteria in the colon, and thus attempt to improve host health (Gibson and Roberfroid,1995). Mannan-oligosaccharides derived from yeast cell wall has generated considerable interest among researchers and commercial livestock producers. A wide variety of oligosaccharides (fructo-oligosaccharides, galacto-oligosaccharides, gluco-oligosaccharides, mannan-oligosaccharides) are commercial available as prebiotic feed additives.

Probiotic bacterial preparations, blend of organic acids and supplemental exogenous enzymes are the long list of alternatives. The word "probiotic" is derived from the Greek, meaning "for Life". Fuller (1989) defined probiotic as "A live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance," Probiotic is a culture of specific living micro organism primarily Lactobacillus,

Synbiotics refer to nutritional supplements combining probiotics and prebiotics and in a form of synergism. The main reason for using a synbiotic is that a true probiotic, without its prebiotic food, does not survive well in the digestive system. Without the necessary food source for the probiotic, it will have a greater intolerance for oxygen, low pH, and temperature. As prebiotics provides a great place for probiotics to thrive, the population of these good bacteria is known to preserve. Synbiotics work in two ways, by improving the viability of probiotics and by delivering specific health benefits (Sekhon and jairath, 2010).

Keeping in mind the beneficial effect of prebiotics and probiotics , the present work was taken up to assess the effect of prebiotics, probiotics and their combination on performance of broilers.

Materials and Methods

The present research work was carried out on a private farm named M.J.(Alpha) poultry farm at dangiya village of dantiwada taluka of Banaskantha district. The research work was conducted for six weeks from 8th September to 20th October, 2013 and began with one hundred andeighty(180) unsexed day old commercial broiler chicks of strain 'Cobb400'.

Total of one hundred eighty unsexed day old commercial broiler chicks of (Cobb 400) strain were procured from M.J. hatchery, Mumanvas. All the chicks were weighed individually using digital weighing balance. The chicks were randomly assigned to four dietary treatment of 45 chicks per treatment. Each group was further divided into three replicates of 15 birds each.

First group of birds were kept as a control and the feed of these group were not supplied with either prebiotic or probiotic in broiler prestarter, starter and finisher diet. Prebiotics in the feed of T_2 group was given at the rate of 500 g/tonne of feed during prestarter (0- 10 days), starter (11-21days) and finisher (22- 42 days) phase. Probiotics in the feed of T_3 group was given at the rate of 100 g/tonne of feed during prestarter, starter and finisher phase. Whereas, in treatment 4 (T_4) combination of prebiotic and probiotic was given at the same level as in T_2 and T_3 during prestarter, starter and finisher phase. The four treatments were : T1 = control (Feed without probiotic or prebiotic supplementationm)

T2 = Prebiotic supplementation in feed (500 g/ tonne of feed)

T3 = Probiotic supplementation in feed (100 g/ tonne of feed)

T4 = Prebiotic (500 g/tonne of feed) + Probiotic (100 g/tonne of feed)

The basal diet was procured from commercial feed mill and considered as control. The Broiler chicks were fed in three phases *viz*. pre-starter (0–10 days), starter (11–21 days) and finisher (22–42 days). Feed and water were offered *ad libitium* to each group throughout experimental period.

The details regarding the proportions of feed ingredients used for manufacturing of basal diet and calculated nutrient composition of basal diet are given in Table 3.2. Nutrient levels of the diets for broilers were based on the NRC (1994) recommendations of nutrient requirements of broiler chickens.

Table 1: Distribution of experimental broiler chicks under various treatments.

Treatments	Replicate 1	Replicate 2	Replicate 3	Total chicks / treatment
T1 Control	15	15	15	**45**
T2 Prebiotic	15	15	15	**45**
T3 Probiotic	15	15	15	**45**
T4 Prebiotic + Probiotic(synbiotic)	15	15	15	**45**

Table 2: Proportion of feed ingredients and nutrient composition (%) of basal diet.

	Proportions (%)		
Ingredients	**Broiler Pre-starter (0-10 d)**	**Broiler Starter (11-21 d)**	**Broiler Finisher (22-42 d)**
Maize	50.28	54.92	60.38
Soyabean meal	42.21	36.73	31.18
Vegetable oil	3.56	4.33	4.85
Dicalcium phosphate	1.93	1.97	1.71
Common salt	0.35	0.35	0.35
Limestone	0.97	1.01	0.93
Maduramycine	0.05	0.05	0.05
Lipocare[1]	0.10	0.10	0.10
L-Lysine	0.17	0.15	0.14
DL-Methionine	0.15	0.15	0.07
Vitamin premix[2]	0.05	0.05	0.05
Mineral premix[3]	0.20	0.20	0.20
Total	100.02	100.01	100.01
Nutrient composition			
ME (Kcal/kg)	2800	2950	3020
Crude Protein (%)	22.90	21.30	19.10
Calcium (%)	0.97	0.92	0.86
Phosphorus (%)	0.45	0.45	0.40

- Lecithin treated with co-enzyme
- Provides per kg of diet: 12500 IU vitamin A; 2500 IU vitamin D3; 12 mg vitamin E; 1.5 mg vitamin K; 1.5 mg vitamin B1; 5 mg vitamin B2; 2 mg vitamin B6, 15 mcg vitamin B12; 15 mg niacin, 10 mg pantothenic acid and 0.5 mg folic acid.
- Provides per kg of diet: 50 mg iron, 10 mg copper, 50 mg zinc, 80 mg manganese, 1 mg iodine and 0.2 mg selenium

A feeding trial of 6 weeks was carried out with the chicks divided into various experimental groups. The birds were reared on deep litter system of housing. The litter material of 3 inch thickness was spread over the floor. Experimental groups and replicates were separated using wire net partitioning. All groups were provided with individual feeder and waterer.

Feed was offered *ad-libitum* in weighed quantity once in a day for first two weeks and then twice a day for rest of experimental period. The feeders were not filled more than two third during first two weeks period, so as to minimize the wastage of feed. Manual turning and mixing of feed was done frequently four to five times in a day. Clean, fresh, wholesome drinking water was made available to all the experimental birds *ad libitum* throughout the study period.

All the experimental chicks were vaccinated against New Castle Disease (Lasota strain) by intra-ocular method at 7thday of age. On 14thday of age chicks were vaccinated against Infectious Bursal Disease(Intermediate strainn). Finally, on 28th day booster dose of New Castle Disease (Lasota Strain) was given. Every care was taken for watering and feeding. Strict and thorough sanitary measures were adopted and care was taken not to allow any scavengers in the poultry house, so as to minimize the disease occurrence.

The following observations related to the objective of the study were recorded regularly for the individual birds as per the schedule described below: Accurate body weight of the individual experimental chicks were recorded in the morning hours before feeding with the help of digital weighing balance at day old and thereafter at weekly interval till six weeks of age.

Broiler chicks were weighed individually at weekly interval up to six weeks of age and the data for weekly body weight gain was obtained by calculating differences between the live body weights of previous week from that of current week and recorded in grams (g).

Weekly Body Weight Gain (g) = Current Week Weight (g) – Previous Week Weight (g)

The weighed quantity of feed was offered to each experimental group under the study and was daily recorded. At the end of week feed left over were collected, weighed and recorded. The difference between the weight of feed offered during period of seven days and the feed left over on the last day was calculated to know the feed consumption of the birds. The average feed intake in gram / bird was calculated for each treatment by dividing the total amount of feed consumed by the number of chicks in the particular treatment during different weeks.

Feed consumption and body weight gain for each week were worked out for each treatment separately.

Statistical Analysis

All the recorded and calculated data were subjected to statistical analysis by applying "Completely Randomized Design" (CRD) employing one-way analysis of variance as per Snedecor and Cochran (1994). A p-value of < 0.05 considered a significant difference among groups and the comparison of means was made using Duncan multiple range test (Steel and Torrie, 1984).

Results And Discussion

Supplementing animal feeds with antibiotic based growth promoters is presently facing serious criticism and has raised global concern as some reports revealed their ill effects among which are development of microbial resistance to the pathogens and their potential harmful effects on human health. These shortcomings led to the search for alternative substances like probiotics, prebiotics and medicinal plants as natural feed additives which can be used in poultry diets to enhance the performance and immune response of birds. In this regard prebiotic and probiotic seems to have potential to be used as growth promoter as an alternative to antibiotics. The present study was undertaken to find out the effect of dietary supplementation of prebiotic, probiotic and synbiotic on growth performance of broiler chicks.

Feed intake

The total feed intake per bird per week during different time period has been presented in table 3.

Total feed intake during first week of age was 137.16 ± 2.28 g, 140.78 ± 4.20 g, 141.51 ± 2.31 g and 141.78 ± 4.64 g for T_1, T_2, T_3 and T_4 groups, respectively. The highest feed consumption was observed in synbiotic supplemented group (T_4) which was followed by T_3, T_2 and T_1 group. There was a non significant difference between all treatment groups, suggests that total feed consumption was not affected by inclusion of prebiotic, probiotic or synbiotic during first week.

Total feed intake during second week was 336.73 ± 11.78 g, 362.49 ± 4.69 g, 343.05 ± 7.58 g and 347.87 ± 6.75 g for T_1, T_2, T_3 and T_4 groups, respectively. The highest feed consumption was in the prebiotic group (T_2) which was followed by T_4, T_3 and T_1 group. There was a non significant difference between all treatment groups.

Total feed consumption during third week was 596.94 ± 23.45 g, 579.42 ± 20.80 g, 596.58 ± 20.96 g and 566.07 ± 18.84 g for T_1, T_2, T_3 and T_4 groups, respectively. The highest feed consumption was in the control group (T_1) which was followed by T_3, T_2 and T_1 group. Feed consumption was not differed by inclusion of prebiotic, probiotic or synbiotic in different treatments.

Total feed consumption during fourth week was 729.38 ± 17.27 g, 731.76 ± 14.15 g, 756.80 ± 16.27 g and 752.82 ± 43.81 g for T_1, T_2, T_3 and T_4 groups, respectively. The highest feed consumption was in the probiotic group (T_3) which was followed by T_4, T_2 and T_1 group. There was a non significant difference between all treatment groups.

Total feed consumption during fifth week was 850.22 ± 15.71 g, 866.40 ± 47.94 g, 888.56 ± 16.82 g and 828.24 ± 25.23 g for T_1, T_2, T_3 and T_4 groups, respectively. The highest feed consumption was in the probiotic group (T_3) which was followed by T_2, T_1 and T_4 group. There was a non significant difference between all treatment groups.

Table 3: Average feed intake (g/bird/week) of broilers under different treatment groups

Weeks	Treatments				Level of Significance
	T1	T2	T3	T4	
I	137.16 ± 2.28	140.78 ± 4.20	141.51 ± 2.31	141.78 ± 4.64	NS
II	336.73 ± 11.78	362.49 ± 4.69	343.05 ± 7.58	347.87 ± 6.75	NS
III	596.94 ± 23.45	579.42 ± 20.80	596.58 ± 20.96	566.07 ± 18.84	NS
IV	729.38 ± 17.27	731.76 ± 14.15	756.80 ± 16.27	752.82 ± 43.81	NS
V	850.22 ± 15.71	866.40 ± 47.94	888.56 ± 16.82	828.24 ± 25.23	NS
VI	1065.89 ± 40.59	1082.53 ± 56.25	1110.51 ± 29.81	1141.82 ± 32.47	NS
0-VI (Total)	3716.31 ± 6.57	3763.38 ±129.88	3837.00 ± 36.51	3778.60 ±122.42	NS

· NS- Non significant

Total feed consumption during sixth week was 1065.89 ± 40.59 g, 1082.53 ± 56.25 g, 1110.51 ± 29.81 g and 1141.82 ± 32.47 g for T_1, T_2, T_3 and T_4 groups, respectively. The highest feed consumption was in the synbiotic group (T_4) which was followed by T_3, T_2 and T_1 group. Feed consumption was not affected significantly by inclusion of prebiotic, probiotic or synbiotic in different treatments.

Total feed consumption during entire experiment (0-6 weeks) was 3716.31 ± 6.57 g, 3763.38 ± 129.88 g, 3837.00 ± 36.51 g and 3778.60 ± 122.42 g for T_1, T_2, T_3 and T_4 groups, respectively. The highest feed

consumption was in the probiotic group (T_3) which was followed by T_4, T_2 and T_1 group. Feed consumption was not affected significantly by inclusion of prebiotic, probiotic or synbiotic in different treatments.

The present result were similar with Anjum *et al.* (2005), Shendare *et al.* (2008) and Kathirvelan *et al.*(2012) as they recorded lower feed consumption than present study. Ramlah and Tan (1995), Elangovan *et al.* (2005), Mountzouris *et al.* (2010), Roozbeh Shabani *et al.*(2012), Houshmand *et al.* (2012) and Seifi *et al.* (2013) had found non-significant effect on feed intake.

Body Weight

The body weights of chicks were recorded at weekly intervals during entire period of 6 weeks, as the changes in body weight is very reliable measure of performance of chicks subjected to various treatments. Average values of body weight under different treatment groups for different weeks is presented in Table 4.

The average initial body weight of the broiler chicks were 42.69 ± 0.45 g, 42.53 ± 0.53 g, 42.64 ± 0.46 g and 42.22 ± 0.41 g under treatment groups T_1,T_2,T_3 and T_4, respectively. The body weight at day old age remained comparable amongs different dietary treatment group including control.

The average body weight at the end of first week were 165.51 ± 1.91 g, 169.60 ± 2.22 g, 169.71 ± 2.23 g and 171.07 ± 2.18 g under treatment groups T_1, T_2, T_3 and T_4, respectively. At the end of first week, highest body weight was observed in the synbiotic group (T_4) (171.07 ± 2.18 g) followed by T_3, T_2 and T_1. The body weight at first week of age did not differ significant among different dietary treatment groups.

The average body weight at the end of second week were 418.91 ± 4.65 g, 438.36 ± 4.52 g, 430.09 ± 5.62 g and 437.69 ± 4.77 g under treatment groups T_1, T_2, T_3 and T_4, respectively.T_2 and T_4 shown higher body weight and also differed significantly ($P<0.05$) with control group while a non-significant difference observed by probiotic supplementation group(T_3). There was a non-significant difference amongst supplement groups. At the end of second week, highest body weight was observed in the prebiotic group (T_2) (438.36 ± 4.52 g) followed by T_4, T_3 and T_1.

The average body weight at the end of third week were 813.13 ± 12.51 g, 822.11 ± 9.93 g, 829.36 ± 10.07 g and 822.62 ± 10.09 g under treatment groups T_1, T_2, T_3 and T_4, respectively. At the end of third week, highest body weight was observed in the probiotic group (T_3) (829.36 ± 10.07 g) followed by T_4, T_2 and T_1.

Table 4: Average body weight (g/bird) of broilers under different treatment groups

Weeks	Treatments			
	T1	T2	T3	T4
Day old	42.69 ±0.45	42.53 ± 0.53	42.64 ± 0.46	42.22 ± 0.41
I	165.51 ±1.91	169.60 ± 2.22	169.71 ± 2.23	171.07 ± 2.18
II	418.91^{a} ±4.65	438.36^{b} ± 4.52	430.09^{ab} ± 5.62	437.69^{b} ± 4.77
III	813.13 ±12.51	822.11 ± 9.93	829.36 ± 10.07	822.62 ± 10.09
IV	1237.18 ±14.38	1249.60 ±11.57	1272.27 ± 11.82	1275.18 ±11.53
V	1675.90^{a} ±16.62	1705.60^{ab} ± 18.28	1748.10^{b} ± 14.57	1727.50^{b} ± 14.63
VI	2184.11^{a} ±25.70	2222.22^{ab} ± 29.83	2276.09^{b} ± 31.29	2284.25^{b} ±20.83

*value bearing different superscript differed significantly ($P<0.05$) ; NS- Non significant

Table 5: Average body weight gain (g/bird) of broilers under different treatment groups

Weeks	Treatments			
	T1	T2	T3	T4
I	122.82 ± 1.92	127.07 ± 2.27	7 ± 2.42	128.84 ± 2.19
II	253.40 ± 4.90	268.76 ± 5.51	8 ± 6.14	266.62 ± 5.48
III	394.22 ± 13.43	383.76 ± 10.14	7 ± 11.28	384.93 ± 10.36
IV	424.04 ± 12.31	427.49 ±11.66	1 ±11.00	452.56 ±11.93
V	438.76 ± 14.14	456.00 ± 12.94	7 ±12.29	449.45 ±12.74
VI	508.18 ±15.40	516.62 ±18.41	2±21.41	556.75 ±9.71
0-VI (Total)	2141.41 ± 25.75	2179.69 ±29.76	)4±32.24	2216.80 ±32.44

The body weight at third week stage did not differ amongst different treatments.

The average body weight at the end of fourth week were 1237.18 ± 14.38 g, 1249.60 ± 11.57 g, 1272.27 ± 11.82 g and 1275.18 ± 11.53 g under treatment groups T_1, T_2, T_3 and T_4, respectively. At the end of fourth week, highest body weight was observed in the synbiotic group (T_4) (1275.18 ± 11.53 g) followed by T_3, T_2 and T_1. The body weight at fourth week stage did not differ amongst different treatments.

The average body weight at the end of fifth week were 1675.90 ± 16.62 g, 1705.60 ± 18.28 g, 1748.10 ± 14.57 g and 1727.50 ± 14.63 g under treatment groups T_1, T_2, T_3 and T_4, respectively.T_3 and T_4 shown higher body weight and also differed significantly (P<0.05) with control group while a non-significant difference observed by prebiotic supplementation group(T_2). There was a non-significant difference amongst supplement groups. At the end of fifth week, highest body weight was observed in the probiotic group (T_3) (1748.10 ± 14.57 g) followed by T_4, T_2 and T_1.

The average body weight at the end of sixth week were 2184.11 ± 25.70 g, 2222.22 ± 29.83 g, 2276.09 ± 31.29 g and 2284.25 ± 20.83 g under treatment groups T_1, T_2, T_3 and T_4, respectively.T_3 and T_4 shown higher body weight and also differed significantly (P<0.05) with control group while a non-significant difference observed by prebiotic supplementation group(T_2). There was a no significant difference among supplement groups. At the end of sixth week, highest body weight was observed in the synbiotic group (T_4) (2284.25 ± 20.83 g) followed by T_3, T_2 and T_1.

The result of present study were inline with earlier work of Ramlah and Tan (1995), Khaksefidi and Rahimi (2005), Hosamani *et al*. (2006), Awad *et al.* (2009), Bozkurt *et al.* (2009), Mayahi *et al.*(2010), Munj *et al.* (2010), Bansal *et al.* (2011), Dizaji *et al*. (2012), Behrouz *et al*. (2012) and Tabidi *et al.* (2013) research workers who had got significantly result of final body weight.

The findings of Anjum *et al.* (2005), Khaksefidi and Rahimi (2005), Hosamani *et al*. (2006), Shendare *et al.*(2008), Awad *et al.* (2009), Bozkurt *et al.* (2009), Munj *et al.* (2010), and Dizaji *et al*. (2012) in which all research workers recorded lower body weight at 6th week of age in comparisom to present findings.

Midilli *et al.* (2008) and Mayahi *et al.*(2010) recorded higher body weight than present study and Amer and Khan (2012) recorded lower body weight than present study whose results were non-significant between treatment groups and control. Dizaji *et al.* (2012) found that prebiotic and synbiotic group was having significantly (P< 0.05) higher body weight than control but probiotic group had non-significant difference with control group.

It was observed that body weight at different age were not differed significantly amongst supplemented groups but they differed (P<0.05) with control group. Synbiotic (T_4) supplemented group gained higher body weight at 1st, 4th and 6th week of age. While probiotic group (T_3) was got the higher body weight at 3rd and 5th week of age. While prebiotic group (T_2) was higher in body weight at 2nd week of age only.

Hence ,it can be concluded that if synbiotic supplied at the rate of combination of prebiotic (500 g/tonne of feed) and Probiotic (100 g/tonne of feed) found most beneficial as compared to prebiotic and probiotic alone.

Body Weight Gain

The data for average gain in body weight for different period of time have been presented in Table 5.

Average gain in the body weight during first week of age were 122.82 ± 1.92 g, 127.07 ± 2.27 g, 127.07 ± 2.42 and 128.84 ± 2.19 g for treatment T_1, T_2, T_3, and T_4 groups, respectively. The higher body weight gain was observed in the synbiotic supplemented group (T_4) which was followed by T_3, T_2 and T_1 groups. The body weight gain of first week of age did not reach upto the significant level.

During period of second week, the gain in body weights was 253.40 ± 4.90 g, 268.76 ± 5.51 g, 260.38 ± 6.14 and 266.62 ± 5.48 g for treatment T_1, T_2, T_3, and T_4 groups, respectively. The higher body weight gain was observed in the prebiotic supplemented group (T_2) which was followed by T_4, T_3 and T_1 groups, but there was a non significant difference between all treatment groups.

During period of third week, the gain in body weights was 394.22 ± 13.43 g, 383.76 ± 10.14 g, 399.27 ± 11.28 and 384.93 ± 10.36 g for treatment T_1, T_2, T_3, and T_4 groups, respectively. The highest body weight gain was observed in the probiotic supplemented group (T_3) which was followed by T_1, T_4 and T_2 groups, but there was a non significant difference between all treatment groups.

Body weight gain during the period of fourth week was 424.04 ± 12.31 g, 427.49 ± 11.66 g, 442.91 ± 11.00 and 452.56 ± 11.93 g for treatment T_1, T_2, T_3, and T_4 groups, respectively. The highest body weight gain was observed in the synbiotic supplemented group (T_4) which was followed by T_3, T_2 and T_1 groups, but there was a non significant difference between all treatment groups.

Average gain in the body weights during fifth week was 438.76 ± 14.14 g, 456.00 ± 12.94 g, 475.87 ± 12.29 and 449.45 ± 12.74 g for treatment T_1, T_2, T_3, and T_4 groups, respectively. The higher body weight gain was in the probiotic supplemented group (T_3) which was followed by T_2, T_4 and T_1 groups, but there was a non significant difference between all treatment groups.

Body weight gain during the period of sixth week was 508.18 ± 15.40 g, 516.62 ± 18.41 g, 529.32 ± 21.41 and 556.75 ± 9.71 g for treatment T_1, T_2, T_3, and T_4 groups, respectively. The highest body weight gain was observed in the synbiotic supplemented group (T_4) which was followed by T_3, T_2 and T_1 groups, but there was a non significant difference between all treatment groups.

Body weight gain during entire experimental period (0-6 week) was 2141.41 ± 25.75 g, 2179.69 ± 29.76 g, 2223.04 ± 32.24 and 2216.80 ± 32.44 g for treatment T_1, T_2, T_3, and T_4 groups, respectively. Probiotic supplemented group (T_3) surpassed all group with highest body weight gain which was followed by T_4, T_2 and T_1 groups, however there was a non significant difference between all treatment groups.

Present findings were similar with earlier findings of Elangovan *et al.* (2005), Li *et al* (2007) and Houshmand *et al.* (2012).

However, it differed from the findings of Yeo and Kim (1997), Khan *et al.* (2000), Islam *et al.* (2004), Anjum *et al.* (2005), Kumar *et al.* (2005), Panda *et al.* (2005), Swain *et al.* (2007), Dabiri *et al.* (2009), Kim *et al.* (2011), and Kathirvelan *et al.* (2012) as they observed significantly higher body weight gain in supplemented group than control group.

Munj *et al.* (2010) found significant ($P<0.05$) difference between synbiotic and control group but prebiotic or probiotic group had non-significant difference with control. Abdel-Raheem and Abd-Allah (2011) found that body weight gain of the probiotic and synbiotic group was significantly ($P<0.05$) higher than control but non-significant difference amongst control and prebiotic group.

The body weight gain during different period failed to achieve significance ($P<0.05$). However, Synbiotic (T_4) supplemented group attained higher gain during 1st, 4th and 6th week of age while probiotic group (T_3) was got the higher body weight at 3rd and 5th week of age whereas prebiotic group (T_2) was higher in body weight at 2nd week of age only.

Present study results were in contrast from Abdel-Raheem and Abd-Allah (2011) as they reported higher feed consumption than present study. Sen *et al.* (2012), Toghyani *et al.* (2011), Taherpour *et al.* (2009) and Kathirvelan *et al.* (2012) had found significant result on feed intake.

Kumar *et al.* (2005) found non-significant difference between supplemental groups and control groups. Midilli *et al.* (2008) found that the synbiotic and control group have non-significant result. Munj *et al.* (2010) and Dizaji *et al.* (2012) found that there was a non significant difference between all treatment groups.

Total feed consumption per bird per week was not affected significantly during whole experimental period in supplemented groups.

pathogenic gut bacteria, thereby improve feed conversion ratio (Bansal *et al.*, 2011). Synbiotic group (T4) gained better FCR during 4th week. So probiotic group (at the rate of 100g/tonne of feed) found to be beneficial as it reduced FCR during most of the stages of the experiment.

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Effect of Dietary Supplementation of Garlic (*Allium Sativum*) Powder as Herbal Feed Additives on Growth Performance in Broilers

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Abstract

It is conceivable that herbal agents could serve as safer alternatives as growth promoters due to their suitability and preference, lower cost of production, reduced risks of toxicity and minimum health hazards. Interestingly recent biological trials of certain herbal formulations in India as growth promoter have shown encouraging results and some of the reports have demonstrated improvement with respect to weight gain, feed efficiency, lowered mortality, increased immunity and increased livability in broiler chicken. Garlic seems to have potential to be used as an alternative to antibiotics and to improve production performance of broilers. Thus, an attempt was made to find out effect of dietary supplementation of garlic (*Allium sativum*) powder as herbal feed additives on acceptability, growth performance, mortality carcass traits and economics of broiler production.

To conduct the study a total of one hundred and eighty, day old broiler chicks of Cobb-400 strain were divided into three treatment groups with 4 replicates of 15 chicks in each using completely randomized design (CRD). All experimental chicks were randomly assigned to 12 pens. There was one control group (T_1) fed on basal diet without any supplement and two treatment groups supplemented with 0.1 % garlic powder (T_2) and 0.5 % garlic powder (T_3). Garlic powder was mixed with control diet as per the proportion. The experiment was carried out for 6 weeks by dividing into two phases starter (0-3 wk) and finisher (4-6 wk). Feed intake and growth performance, were studied. Feed intake, body weight, body weight gain were recorded weekly. Average feed intake in gram/chick/week was calculated by dividing the total amount of feed by the number of chicks in the particular pen on particular week. The weekly average body weight gain was calculated by difference between the body weight of current and earlier weeks.

The body weight of birds was higher ($P<0.001$) in garlic supplemented birds as compared to without supplemented control, with better weight in 0.1 % garlic powder (T_2) supplemented birds as compared to 0.5 % garlic powder (T_3) supplemented birds. Body weight gain was differ significantly at the end of 1^{st} ,2^{nd} ,3^{rd}, 4^{th} week of age with better gain in 0.1 % garlic powder supplemented birds as compared to without supplemented control and 0.5 % garlic powder supplemented birds. The body weight gain of 6^{th} week differ significantly ($P<0.001$) with better gain in 0.1 % garlic powder supplemented birds followed by 0.5 % garlic supplemented birds and subsequently without supplemented control.

The overall body weight gain was higher ($P<0.001$) in 0.1 % garlic supplemented birds subsequently by 0.5 % garlic supplemented birds as compared to without supplemented control. The total feed intake (0-6 wk) was significantly ($P<0.05$) superior in birds supplemented with 0.1 % garlic (T_2) as compared to birds that were supplemented with 0.5 % garlic (T_3) and without supplementation (T_1). Dietary supplementation of garlic @ 0.1 % in broiler diet had beneficial effect on body weight gain, feed intake, feed conversion ratio and dressed yield. Dietary supplementation of 0.1% garlic had beneficial effect in broilers for improving performance and also serves as one of the potential alternative to antibiotic growth promoter as well as reducing the cost of production in commercial broiler farming.

Keywords: Farming; Industry, Weight Gain; Supplementation; Herbal Promoters.

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Introduction

Poultry industry is one of the fastest expanding segments of agro-livestock sector in India. The potential of poultry farming as a viable industry is reflected in the amazing growth of the agriculture sector during last three decades and the same has not been recorded in any other agriculture sector. Poultry occupies an important place in Indian economy contributing more than ' 11,000 crores to the national gross domestic products. India ranks 3rd and 5th with respect to production of egg and meat respectively in the world (BAHS, 2010). The per capita availability of poultry meat is 2.15 kg/annum which is very less as against the recommendation of 11 kg meat/annum given by National Institute of Nutrition (Prabhakaran, 2012). Now a day, the efficiency of poultry to convert the feed into meat plays a key role in economics of broiler industry. Therefore, it is highly essential to improve feed efficiency of poultry to produce meat economically and also food safety is more seriously considered than before. On the other hand, economy of food production is also a factor that cannot be ignored. A huge amount of antibiotics have been used to control diseases and improve performances in livestock. However, due to growing concerns about antibiotic resistance and the potential for a ban for antibiotic growth promoters in many countries in the world, there is an increasing interest in finding alternatives to antibiotics in poultry production.

Feed additives are commonly described as non-nutrient substances that accelerate growth, efficiency of feed utilization, beneficial for health or metabolism of the animals (Church and Pond, 1988). The additives that hold great promise in the feeding of poultry comprise of antibiotics, coccidiostats, antioxidants, enzymes, hormones, probiotics, buffers, organic acids, mould inhibitors, herbal products, synthetic micronutrients etc. Antimicrobial compounds produced by microorganisms have been used in poultry rations as growth promoters for many years (Church and Pond, 1988; Barragry and Powers, 1994).

Herbal feed additives are usually defined as products derived from plants and added to animal feed as alternatives to antibiotics, growth promoter, fattening agent to increase productivity, improving the quality of feed and animal hygiene conditions thereby to improve the quality of produced food. Feed additives produced from plants have often a significant antibacterial effect, thereby suppressing pathogenic microflora in the gastrointestinal tract of animals and thus reducing mortality during the fattening period, especially during stress (Schone *et al*., 2006). Plant additives are added into feedstuff as they improve the taste and smell of feed and thus improve intake and growth of animals (Windisch *et al*., 2008). Several herbal additives contain substances which increase the production of digestive juices (saliva, gastric juices, pancreatic and intestinal secretion) and thereby enhance appetite and digestion (Barreto *et al*., 2008). There are many herbal additives which have shown promising results as alternative to antibiotics as well as improvement in production performance of broilers. Few of such herbal additives include garlic, fenugreek, thyme, oregano etc.

Garlic (*Allium sativum*) has been used as a spice and a native medicine since long ago (Rivlin, 2001). Garlic belongs to family *Liliaceae* and the genus *Allium*. Bioactive components of garlic like sulfur containing compounds (Alliin, Diallylsulfides and Allicin) are responsible for its some of the specific characteristics (Amagase *et al*., 2001). It has been indicated that these compounds have antibacterial, antifungal, anti parasitic, antiviral, antioxidant, antithrombotic, anti cancerous and vasodilator characteristics. Garlic powder as a natural growth promoter can be a potential alternative for common artificial growth promoters like antibiotics and in this respect, it can improve growth rate, feed conversion ratio (FCR), carcass characteristics and decrease mortality rate in broiler chickens (Demir *et al*., 2003; Lewis *et al*., 2003; Tollba and Hassan, 2003). Garlic has been found to lower serum and liver cholesterol (Qureshi *et al*., 1983), inhibit bacterial growth (Cavallito and Bailey, 1994), inhibit platelet growth and reduce oxidative stress (Horie *et al*., 1992).

The mechanism of action of garlic as a growth promoter is yet to be fully elucidated. In this backdrop, the investigation was planned to study the effect of dietary supplementation of garlic (*Allium sativum*) powder as herbal feed additives on acceptability, growth performance, carcass traits and economics of production in broilers.

Materials and Methods

The experiment was carried out from day old age up to 6 weeks of age from 8th September 2013 to 20th October 2013 at private poultry farm at Dangia village in Dantiwada taluka of Banaskantha district nearby area of College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) and the laboratory work was carried out in the

Department of Animal Nutrition of the College.

Experimental Materials

Total of one hundred and eighty unsexed day old commercial broiler chicks of same strain (Cobb-400) and hatch were procured from sunrise hatchery, Mumanvas (Dist: Banaskantha) were used. Experimental chicks were divided into three treatment groups with 4 replicates of 15 chicks each using completely randomized design (CRD). Chicks were randomly assigned to 12 pens. The day old chicks were weighed individually with standard electronic weighing balance and it was taken as initial body weight of chicks.

Garlic (*Allium sativum*) powder was used as a herbal feed additive and garlic bulb was procured from local market then powdered in an electrical grinder air dried and stored in air tight container at room temperature for use.

Treatments And Feeding Standard

The experimental design consisted of three dietary treatments as follow:

T_1 = Basal diet without garlic supplementation (Control)

T_2 = Basal diet + garlic supplementation @ 0.1% of feed

T_3 = Basal diet + garlic supplementation @ 0.5% of feed

The detailed plan of various treatments is shown in Table 1. The basal diet was formulated and made available from commercial feed mill in mash form and considered as control. The broiler chicks were fed in two phases viz. starter (0–21 days) and finisher (22–42 days). Feed and water were offered *ad-libitium* to each group throughout experimental period. The details regarding the proportions of feed ingredients used for manufacturing of basal diet and calculated nutrient composition of basal diet are given in Table 1 All the treatment feeds were fortified with adequate vitamins, coccidiostats and other supplements.

Table 1: Treatments and number of broiler chicks assigned randomly to various experimental groups.

Group	Treatments	Replicates			
		R_1	R_2	R_3	R_4
T_1	Control diet	15	15	15	15
T_2	Control diet supplemented with 0.1 % garlic powder	15	15	15	15
T_3	Control diet supplemented with 0.5 % garlic powder	15	15	15	15

Garlic powder was mixed with control diet as per the proportion mentioned in treatments for the particular group and offered to birds. The proximate analyses of the experimental feeds were carried out as per AOAC (1999).

** Analyzed values as fed basis

***calculated values as fed basis

*Constant includes trace mineral premix 0.1, vitamin premixes 0.215, toxin binder 0.05 and coccidiostat 0.05 %. Trace mineral premix supplied Mg-300, Mn-55, I-0.4, Fe-56, Zn-30 and Cu- 4 mg/kg diet. The vitamin premixes supplied vitamin A 8250 IU, vitamin D_3 1200 ICU; vitamin K 1 mg; vitamin E 40 IU, vitamin B_1 2 mg, vitamin B_2 4 mg, vitamin B_{12} 10 mcg; niacin 60 mg; pantothenic acid 10 mg and choline chloride 500 mg/kg diet.

Proximate Analysis of Experimental Diets

Proximate analysis of starter and finisher feed was carried out for various proximate principles by standard analytical procedures of AOAC (1999) at Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat).

Management of Birds

Housing management

A feeding trial of 6 weeks was carried out with the chicks divided into various experimental groups. All the experimental birds

Table 2: Ingredients and nutrient composition of basal diet used during starting (0-3 wk) and finishing (4-6wk) phase

Ingredients (kg/100kg)	Starter (%)	Finisher (%)
Yellow maize	56.6	60.4
Soybean meal	36.5	34
Rapeseed meal	3.5	2.5
Limestone powder	0.9	0.9
Dicalcium phosphate	1.7	1.45
Common salt	0.3	0.3
DL-Methionine	0.11	0.07
Constant*	0.415	0.415
Total	100.03	100.04
Nutrient composition (As fed basis)		
ME, kcal/kg***	2867.8	2905.7
Crude Protein, %**	22.13	20.89
Lysine,%***	1.27	1.15
Methionine,%***	0.52	0.46
Calcium,%***	0.92	0.86
Phosphorus, %***	0.45	0.40
Ether extract,%**	4.76	4.64
Crude fiber,%**	3.5	3.4
Total ash,%**	3.38	3.22

Ingredients and nutrient composition of basal diet is given in Table 2. were reared in deep litter system of housing under same environmental condition. An ideal and identical floor, feeding and watering space was allotted to experimental birds. Experimental groups were divided into 12 (twelve) pen by wire net partitioning.

Feeding and watering management

All groups were provided with individual feeder and waterer. Feed was offered *ad-libitum* in weighed quantity once in a day for first two weeks and then twice a day for rest of experimental period. The feeders were not filled more than two third during first two weeks period, so as to minimize the wastage of feed. Manual turning and mixing of feed was done frequently four to five times in a day. Clean, fresh wholesome drinking water was made available to all experimental birds *ad libitum* throughout the experimental period.

Observations Recorded

The following observations related to the objective of the study were recorded regularly for the individual birds as per the schedule described below:

Body weight

Accurate body weight of the individual experimental chicks were recorded in the morning hours before feeding with the help of digital weighing balance at day old age and thereafter at weekly interval till six weeks of age.

Body weight gain

Broiler chicks were weighed individually at weekly interval up to six weeks of age and the data for average weekly body weight gain was obtained by calculating differences between the average live body weight of previous week from that of current week for each treatment groups and recorded in grams (g).

Feed intake

The daily weighed quantity of feed offered to each experimental group under the study was recorded. At the end of week left over feed were collected, weighed and recorded. The difference between the weight of feed offered during period of seven days and the feed left over on the last day for each treatment was calculated to know the average feed intake for each treatment groups. Average feed intake in gram/ week was calculated by dividing the total amount of feed consumed by the number of chicks in the particular pen for particular week.

Statistical Analysis

The data pertaining to various parameters were analyzed statically by the methods of Snedecor and Cochran (1994). The significant mean differences were tested as per Duncan's multiple range test (DMRT) described by Duncan (1955).

Results and Discussion

Supplementing animal feeds with antibiotic based growth promoters is presently facing serious criticism and has raised global concern as some reports revealed their ill effects among which are development of microbial resistance to the pathogens and their potential harmful effects on human health (Rahmatnejad *et al*., 2009). These shortcomings led to the search for alternative substances like probiotics, prebiotics and medicinal plants as natural feed additives which can be used in poultry diets to enhance the performance and immune response of birds (Rahmatnejad *et al*., 2009). In this regard garlic powder seems to have potential to be used as growth promoter as an alternative to antibiotics.

The present study was carried out to know the effect of dietary supplementation of garlic (*Allium sativum*) powder as herbal feed additive on performance of broilers.

Body Weight (BW)

The body weight of individual broiler chicks were recorded initially and at the end of every week during entire period of 6 weeks, as the changes in body weight is very reliable measure of performance of chicks subjected to various treatments. Weekly body weight of broilers under different treatments groups are presented in Table 3.

The average body weight of selected broiler chicks at day old age were 42.28 ± 0.31, 42.27 ± 0.32 and 42.18 ± 0.33 g under treatment group T_1, T_2 and T_3, respectively. The corresponding average final body weight at the end of six weeks were 2013.69 ± 6.89, 2097.02 ± 5.86 and 2039.95 ± 3.77 g in the T_1, T_2 and T_3 experimental groups, respectively.

Table 3: Weekly body weight (g/bird/week) of broilers under different treatment groups.

Weeks	Treatments		
	T_1	T_2	T_3
Day Old	42.28 ± 0.31	42.27 ± 0.32	42.18 ± 0.33
1st	166.00 ± 1.39^a	173.45 ± 1.28^b	166.83 ± 1.20^a
2nd	403.79 ± 2.21^a	418.93 ± 1.86^b	405.58 ± 1.67^a
3rd	738.48 ± 3.21^a	768.55 ± 3.09^b	741.78 ± 3.69^a
4th	1172.16 ± 3.95^a	1215.97 ± 3.54^b	1180.56 ± 3.72^a
5th	1598.34 ± 6.31^a	1634.67 ± 3.68^b	1607.58 ± 3.75^a
6th	2013.69 ± 6.89^a	2097.02 ± 5.86^c	2039.95 ± 3.77^b

Note: Values superscripted with different letter in the same row differ significantly. NS: Non-significant.

The body weight of birds was higher (P<0.001) in garlic supplemented birds as compared to without supplemented control birds. When the diet of birds were supplemented with 0.1 % garlic powder (T_2) resulted in higher (P<0.001) body weight as compared to birds fed with 0.5 % garlic powder (T_3). The present findings were in line with earlier work of, Mahmood *et al*. (2009) and Aji *et al*. (2011). In contrary to our findings, Rahimi *et al*. (2011) reported that garlic supplementation had no significant effect on body weight.

Body Weight Gain (BWG)

The biological response of growth was also interpreted in terms of body weight gain. Weekly body weight gain of broilers under different treatment groups are presented in Table 4 and Overall (0-6 wk) body weight gain (g/bird) of broilers in under different treatment groups in Table 5.

At the end of 1st, 2nd, 3rd and 4th week of age birds fed with 0.1 % garlic had significant effect on body weight gain as compared to without supplemented control and 0.5 % garlic fed birds. The comparable effect was observed on 5th week body weight gain while the body weight gain of 6th week differ significantly (P<0.001) with better gain in 0.1 % garlic powder fed birds followed by 0.5 % garlic fed birds and without supplemented control (T_1).

The overall body weight gain for 0-6 weeks of age

Table 4: Weekly body weight gain (g/bird/week) of broilers under different treatment groups.

Weeks	Treatments		
	T_1	T_2	T_3
1st	123.75 ± 1.38[a]	131.18 ± 1.20[b]	124.61 ± 1.09[a]
2nd	237.64 ± 1.79[a]	245.48 ± 1.44[b]	238.75 ± 1.43[a]
3rd	334.69 ± 2.45[a]	349.62 ± 2.41[b]	336.20 ± 2.99[a]
4th	433.67 ± 2.43[a]	447.42 ± 2.50[b]	438.78 ± 3.23[a]
5th	426.19 ± 4.20	418.70 ± 1.98	427.02 ± 3.47
6th	415.34 ± 4.04[a]	462.35 ± 4.03[c]	432.37 ± 3.33[b]

Note: Values superscripted with different letter in the same row differ significantly. NS: Non- significant.

Table 5: Overall (0-6 wk) body weight gain (g/bird) of broilers under different treatment groups.

Replications	Treatments		
	T_1	T_2	T_3
Mean ±SE	1971.50 ± 6.92[a]	2054.70 ± 5.77[c]	1997.70 ± 3.68[b]

ANOVA

Sources of variation	SS	D.F	MSS	'F' Value	Significance
Between groups	214664.54	2	107332.27	57.92	0.001
Within groups	322425.39	174	1853.02		
Total	537089.93	176			

were 1971.50 ± 6.92, 2054.70 ± 5.77 and 1997.70 ± 3.68 g in treatment T_1, T_2 and T_3, respectively. The overall body weight gain was higher (P<0.001) in 0.1 % garlic (T_2) fed birds followed by 0.5 % garlic (T_3) fed birds as compared to without supplemented control (T_1). Earlier studies have reported mixed responses in body weight gain to garlic supplementation. Our findings were corroborated with earlier findings of Pourali *et al*. 2010; Mansoub, 2011; Stanacev *et al*. 2011 and Suriya *et al*. 2012. On the other hand, non-significant effect of garlic supplementation was reported by Fadlalla *et al*. 2010; Mansoub and Nezhady, 2011 and Rahimi *et al*. 2011. In present study better weight gain in garlic fed birds may be due to the action of allicin, an organosulfur compound which inhibits the growth of pathogenic bacteria and aflatoxin producing fungi leading to improved gut environment (Reeds *et al*., 1993; Meraj, 1998 and Cullen *et al*., 2005) and also due to promoting effect of allicin on intestinal flora, thereby improving digestion and enhancing the utilization of energy, leading to improved growth (Lewis *et al*. 2003).

Feed Intake (Fi)

The most important factor affecting the profitability in broiler farming is feed cost which constitutes a major component of expenditure and may contribute about 70 to 75 % of total cost of broiler production. Weekly feed intake of broilers under different treatment groups are presented in Table 6.

The average feed consumed by birds for first week of age in T_1, T_2 and T_3 experimental groups were 171.06 ± 2.52, 176.33 ± 0.40 and 171.59 ± 3.72 g respectively. The dietary supplementation of garlic powder did not bring any significant effect on feed intake during 1st, 2nd, 4th and 5th week of age. However, when birds were supplemented with 0.1 % of garlic increase in feed intake during 3rd and 6th week of age.

The overall (0-6 wk) feed intake was 3461.10 ± 36.69, 3615.70 ± 8.82 and 3514.70 ± 50.46 g/bird in T_1, T_2 and T_3, respectively as shown in Table 7.. The total feed intake (0-6 week) was significantly (P<0.05) better in birds receiving 0.1 % garlic (T_2) powder as compared to birds that are receiving either 0.5 % garlic (T_3) or without supplementation (T_1).

Table 6: Weekly feed intake (g/bird/week) of broilers under different treatment groups.

Weeks	Treatments		
	T_1	T_2	T_3
1st	171.06 ± 2.52	176.33 ± 0.40	171.59 ± 3.72
2nd	342.58 ± 1.39	350.39 ± 2.05	342.55 ± 7.62
3rd	542.07^{a} ±10.59	571.92^{b} ± 1.60	550.65^{ab} ± 6.99
4th	760.60 ± 4.91	768.72 ± 2.76	771.27 ± 11.74
5th	794.79 ± 12.66	803.95 ± 10.46	807.00 ± 10.07
6th	850.00^{a} ± 6.38	944.42^{b} ± 3.68	871.67^{a} ± 12.98

Note: Values superscripted with different letter in the same row differ significantly. NS-Non-significant.

Findings of the present study were in line with earlier findings of Javandel *et al.* (2008). They reported that feed consumption was significantly higher in birds fed diets with lower concentration of garlic 0.125 and 0.25 % as compared to higher level 0.5, 1 and 2 %. Similar findings were also reported by many workers. Isa (2011); Mansoub and Myandoab (2011); Mansoub and Nezhady (2011). In contrast to our findings Choi *et al*. (2010); Fadlalla *et al*. (2010); Onu (2010); Raeesi *et al*. (2010); Aji *et al*. (2011); Mansoub (2011) and Rahimi *et al*. (2011) reported non-significant effect of garlic supplementation on feed intake in broilers.

Conclusion

Dietary supplementation of garlic @ 0.1 % in broiler diet had beneficial effect on body weight gain and feed intake.Better survivability was observed in 0.1 % garlic supplemented birds as compared to 0.5 % garlic supplemented birds or without supplemented

Table 7: Overall (0-6 wk) feed intake (g/bird) of broilers under different treatment groups.

Replications	Treatments		
	T_1	T_2	T_3
Mean	3461.10	3615.70	3514.70
±SE	±36.69[a]	±8.82[b]	±50.46[ab]

ANOVA

Sources of variation	SS	D.F	MSS	'F' Value	Significance
Between groups	49318	2	24658.79	4.658	0.041
Within groups	47645	9	5293.91		
Total	96963	11			

control.Dietary supplementation of 0.1% garlic had beneficial effect in broilers for improving performance and also serves as one of the potential alternative to antibiotic growth promoter as well as reducing the cost of production in commercial broiler farming. Though the findings of the study are concrete and encouraging but further detail investigations are required to determine the effect of garlic supplementation on performance and welfare of broiler chickens under various agro-climatic conditions.

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Role of Probiotic in Milk and its Byproducts

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Abstract

Probiotics are living microorganisms which when ingested have beneficial effects on the equilibrium and the physiological functions of the human intestinal microflora. Probiotics have been recently defined as "live microbes which transit the gastro-intestinal tract and in doing so benefit the health of the consumer (Tannock *et al*., 2000). The origin of cultured dairy products dates back to the dawn of civilization. Metchnikoff's studies into the potential life-lengthening properties of lactic acid bacteria *Lactobacillus delbrueckii* subsp. *bulgaricus*, inspired Japanese scientist Minoru Shirota to begin investigating the causal relationship between bacteria and good intestinal health. *Bifidobacterium* were first isolated from a breast-fed infant by Henry Tissier in 1900. live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance (Roy Fuller,1989). The micro biota of a newborn develops rapidly after the birth. It is initially dependent mainly on: the mother's micro biota, mode of delivery, birth environment and rarely genetic factors. After infancy probiotics are supplied to us by raw foods; lactic acid fermented foods. Now a day, consumers are aware of the link among lifestyle, diet and good health, which explains the emerging demand for products that are able to enhance health beyond providing basic nutrition. The release of different bioactive peptides from milk proteins through fermentation by LAB is now well documented. PUFA (polyunsaturated fatty acids) is higher than saturated fatty acids in meat products. Probiotics are extremely sensitive to heat and other processing conditions. New technologies, like microencapsulation and immobilized cell technologies, offer additional protection to probiotic organisms and new ways to include probiotics in foodstuffs.

Key Words: Dairy Products; Probiotics; Supplement; Peptides; Fermentation; PUFA; Processing.

Introduction

Probiotics are living microorganisms which when ingested have beneficial effects on the equilibrium and the physiological functions of the human intestinal microflora. Probiotics have been recently defined as "live microbes which transit the gastro-intestinal tract and in doing so benefit the health of the consumer (Tannock *et al*., 2000) differing from the earlier definitions which focused on probiotic interactions with indigenous intestinal microbes (Fuller, 1989). These definitions of probiotic bacteria generally agree that probiotic bacteria should be living organisms to confer health benefits. Probiotics have been reported to play a therapeutic role by modulating immunity, lowering cholesterol, improving lactose tolerance and preventing some cancers (Kailasapathy and Chin, 2000). In the recent past, there has been an explosion of probiotic-based health products mostly in the form of fermented dairy products as well as dietary supplements. The markets

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for probiotic products and supplements are increasing worldwide (Playne, 1997). Today there are more than 70 "Bifidus"- and "Acidophilus"-containing products worldwide, including several fermented dairy products (Shah, 2001). Viability of probiotic bacteria in a product at the point of consumption is an important consideration for their efficacy, as they have to survive during the processing and shelf life of food and supplements, transit through high acidic conditions of the stomach and enzymes and bile salts in the small intestine. The consumption of probiotics at a level of 10^8-10^9 cfu/g per day is a commonly quoted figure for adequate probiotic consumption, equating to 100 g of a food product with 10^6-10^7 cfu/g (Kebary, 1996).

History of probiotics

The origin of cultured dairy products dates back to the dawn of civilization; they are mentioned in the Bible and the sacred books of Hinduism. Climatic conditions for sure favoured the development of many of the traditional soured milk or cultured dairy products such as kefir, kumis, leben and dahi. These products, many of which are still widely consumed, had often been used therapeutically before the existence of bacteria was recognized. In 1907, Metchnikoff developed a theory that aging is caused by toxic bacteria in the gut and that lactic acid could prolong life. Based on this theory, he drank sour milk every day. Metchnikoff's studies into the potential life-lengthening properties of lactic acid bacteria *Lactobacillus delbrueckii* subsp. *bulgaricus*, inspired Japanese scientist Minoru Shirota to begin investigating the causal relationship between bacteria and good intestinal health, which eventually led to the worldwide marketing of Kefir and other Fermented milk drinks, or probiotics. And also reported that intake of yogurt containing lactobacilli reduces toxin-producing bacteria in the gut and this increases the longevity of the host.

Bifidobacterium were first isolated from a breast-fed infant by Henry Tissier in 1900 who also worked at the Pasteur Institute. The isolated bacterium named *Bacillus bifidus communis* was later renamed to the genus *Bifidobacterium*. Tissier found that *Bifidobacterium* are dominant in the gut flora of breast-fed babies and he observed clinical benefits from treating diarrhoea in infants with Bifidobacteria. *Bifidobacterium lactis* is used as a probiotic in a variety of foods, particularly dairy products like yogurt, and is also included in baby food. The most important effects noted were that Bifidobacterium is able to alter pro-carcinogenic enzymes, prevent pro-carcinogens and suppress tumours. Although there are many species of *Bifidobacterium*, some of the more important ones are B. *bifidum*, B. *longum*, B. *infantis* and B. *lactis.*

The term *probiotic*, meaning "for life," is derived from the Greek language. *"Substances produced by microorganisms which promote the growth of other microorganisms" (Lilly and Stillwell, 1965).*

Parker (1974) coined the term probiotic and defined the term as "organisms and substances which contribute to intestinal microbial balance".

Roy Fuller (1989), an expert in gut micro-ecology given the modern definition of the probiotic concept and also modified Parker's definition to: "live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance". This new definition removed the word "substances" which could have included antibiotics. Moreover, Fuller's definition emphasizes the requirement of viability for probiotics and introduces the aspect of a beneficial effect on the host.

Source of Probiotics

The micro biota of a newborn develops rapidly after the birth. It is initially dependent mainly on: the mother's micro biota, mode of delivery, birth environment and rarely genetic factors. The maternal vaginal and intestinal flora constitutes the source of bacteria, which colonizes the intestine of the newborn. After infancy probiotics are supplied to us by raw foods; lactic acid fermented foods such as yogurt and cheese; and probiotic supplements (Kaur *et al.*, 1995).

Selection of strains for probiotic use should always follow two general principles: safety of the organism, and possessing desirable characteristics for its intended use. Intestinal probiotics are dominated by members of *Bifidobacterium* and *Lactobacillus,* as these two genera have a long history of safe use and have GRAS (generally regarded as safe) status. They are also very suited to augmenting the intestine, as *Bifidobacterium* is a major inhabitant of the large intestine and *Lactobacillus* is a major inhabitant of the small intestine. The origin of the strains used in probiotics can be either freshly isolated from a human or animal host or from a culture collection. Culture collection strains have generally been extensively cultivated in fermentation systems and thus have likely attenuated to suit the *in vitro* environment. However, as stated *by* (Havenaar *et al.*, 1992) the choice of where to get a probiotic strain depends on the specific purpose of the probiotic. For example, if only transient activity of the probiotic is needed, such

as for lactose digestion, then it is not necessary for the probiotic to have characteristics that would enable it to colonize the host. Most probiotic effects in the GI system would be enhanced if the probiotic would be able to compete with the indigenous flora. This requires a more careful selection of strains. Although all the criteria for this purpose are not currently known for any intestinal organism, there is one general consensus pertaining to a criterion that is important. That consensus is that the probiotic should originate from the same animal species that it is intended to target. The rationale is that the intestinal environments in different animal species are sufficiently different such that the most competitive bacteria in each host species have evolved specific traits for survival in that host (Freter, 1992). Human probiotics, therefore, should originate from a human source if the objective is to effectively modulate the microbial populations at their target sites. It is noteworthy that when commercial probiotics are fed to human subjects during controlled feeding studies, the probiotic can be detected in high numbers in the faeces during the feeding period, but rapidly disappears following cessation of feeding (Berg, 1998). The rate of decrease of the probiotic such as *Lactobacillus rhamnosus* GG can in some cases persist longer than a week post feeding (Alander, 1998).

Probiotic foods are a group of health-promoting functional foods, with large commercial interest and growing market shares (Arvanitoyannis and Van Houwelingen, 2005). In general, their health benefits are based on the presence of selected viable strains of lactic acid bacteria (LAB), that, when taken up in adequate amounts, confer a health benefit on the host (FAO/WHO, 2001). They are administered mostly through the consumption of fermented milks or yoghurts (FAO/WHO, 2001; Makras, 2004).

In addition to their common use in the dairy industry, probiotic LAB strains may be used in other food products, including fermented meats (Hammes and Hertel, 1998; Incze, 1998). Although the concept is not new, only few manufacturers consider the use of fermented sausages as carriers for probiotic LAB (Arihara *et al.*, 2006). Since meat products are seldom perceived as ''healthy foods", due to the perceived image of meat and its controversial nutrient profiling clause with respect to the presence of nitrite, salt, and fat, their marketing potential may be compromised (Lücke, 2000). In addition, the more artisan orientation of sausage manufacturers as compared to the dairy industry, the larger variety of products, and a number of uncertainties concerning technological, microbiological, and regulatory aspects seem to be problematic (Ross *et al.*, 2005).

Probiotic foods are gaining importance due to Peoples having a demand for healthier foods because of health awareness. Now a days peoples are growing about self care movement. Rise in ageing population lead to have awareness concerned with promoting of health. Generally, women are more concerned with body image and health. Parents are also monitoring their children's diets much more closely, as they are becoming more aware of the increasing global prevalence of childhood obesity and the dangers associated with it, such as diabetes, heart disease, and high cholesterol and blood pressure. In order to try and prevent childhood obesity and improve overall health and wellness, parents are purchasing healthier snacks, and more organic fruits and vegetables for their children. Manufacturers are also heavily advertising the nutritional benefits of certain functional ingredients to parents, such as omega-3, which is believed to aid in brain and eye development, and fibre, which is thought to improve digestive health, control hunger and improve heart health. Pregnant women have also become a significant target group, as they increasingly purchase organic and fortified/ functional foods to help ensure a healthy pregnancy and child. According to a recent Mintel study, 62% of children surveyed indicated that they like eating healthy snacks. Snacking has become the 4th meal of the day, and parents are increasingly looking to buy healthy snacks for their children. As the Ageing Population, a significant portion of the world population is now over 55 years of age, especially within North America, Western Europe, and China. This consumer segment has now become a major target group for the health and wellness industry, due to their increasing concern for improving their health and maintaining their lifestyles. The ageing population spends a significant amount of money on healthier foods, exercise equipment, and supplements. This particular group of consumers is highly interested in maintaining a healthy lifestyle and a certain level of vitality long into their retirement. Today's ageing population is also highly educated because of the increasing amount of information available to them (Global Health and Wellness, 2011).

Common Probiotic Candidates

- Lactobacillus spp.
- Bifidobacterium spp.
- Streptococcus salivarius ssp. thermophilus
- Enterococcus faecium
- Lactococcus lactis ssp lactis

- Lactococcus lactis ssp cremoris
- Leuconostoc mesenteroides ssp dexranicum
- Propionobacterium freudenreichii
- Pediococcus acidilactis
- Saccharomyces boulardii

Strains for milk products

- L.*helveticus* cp 790
- L.*rhamnosus* GG
- L. *bulgaricus* ss1
- Lactococcus *lactis ssp cremoris* FT4 (Gobetti *et al*., 2002).

Strains for meat products

- *Lactobacillus sakei* Lb 3
- *Lactobacillus casei/paracasei*
- L. *rhamnosus* (Collins *et al.,* 2007)
- L.*sakei*
- L. *plantarum (*Penacchia *et al.,* 2006*)*
- Pediococcus *acidilactici* PA-2 (Erkkila and Petaja, 2000)
- Yeasts -Candida and Saccharomyces
- Mesophillic lactobacilli (Shameshima *et al*., 1998)

Global scenario of Probiotic foods

Global probiotics demand was worth USD 27.9 billion in 2011 and is expected to reach USD 44.9 billion in 2018, growing at a Compound Annual Growth Rate **(**CAGR) of 6.8% from 2013 to 2018. Asia-Pacific and Europe dominate the global market in terms of demand, while Asia-Pacific is also expected to be the most promising market in the near future. The global market for probiotics is mainly driven by high demand for probiotic yogurt and growing consumption of functional food. Growing consumer awareness regarding gut health has played a key role in sustained growth of these ingredients (Transparency market research, 2013). The probiotic foods are accepted by 76% of consumers of the world. *Lactobacillus* genus share 61.9% of the total probiotic product produced in the world. Probiotic added meat products marketed since 1998 by German and Japanese producers – Salami (Salami is cured sausage, fermented and air-dried meat) (Arihar, 2006).

Probiotics and Human Health

Now a day, consumers are aware of the link among lifestyle, diet and good health, which explains the emerging demand for products that are able to enhance health beyond providing basic nutrition. The list of health benefits accredited to functional food continues to increase and the probiotics are one of the fastest growing categories within food for which scientific researches have demonstrated therapeutic evidence. Among several therapeutic applications of the probiotics can be cited the prevention of urogenital diseases, alleviation of constipation, protection against traveller's diarrhoea, reduction of hypercholesterolemia, protection against colon and bladder cancer, prevention of osteoporosis and food allergy (Lourens Hattingh and Viljoen, 2001). Ingestion of LAB has been suggested to confer a range of health benefits including immune system modulation (Isolauri *et al.*, 2001). Maldonado *et al*., 2009 studied the effect of fermented milk containing *Lactobacillus casei* which induced mucosal immune stimulation reinforcing the non-specific barrier and modulating the innate immune response in the gut, maintaining the intestinal homeostasis. Host immune modulation is one of the suggested benefits of the consumption of probiotic functional food. However, comparative studies on the immunological properties that support the selection of strains of the same species for specific health benefits are limited. Medina *et al*., 2007 evaluated the ability of different strains of *Bifidobacterium longum* to induce cytokine production by peripheral blood mononuclear cells. *B. longum* live cells of all strains induced specific cytokine patterns, suggesting that they could drive immune responses in different directions. Kelly *et al*., 2004 demonstrated the ability of species within the commensal microflora to modulate immune function. Arunachalam *et al*., 2000 studied the dietary consumption of *B. lactis* and concluded that a relatively short-term dietary regime (6 weeks) is sufficient to impart measurable improvements in immunity. Chiang *et al*., 2000 demonstrated that dietary consumption of probiotics in oligosaccharide-rich substrate enhanced immune function by *B. lactis* in a different range for two types of leucocytes. *In vivo* and *in vitro* indices of immunity in healthy mice fed with *Lactobacillus rhamnosus*, *L. acidophilus* and *B. lactis* were examined by Gill *et al*., 2000 and the results suggested that supplementation of the diet with these strains was able to enhance several indices of natural and acquired immunity. Infectious diseases are still the biggest human health problem for the world to solve. Intestinal infection caused by the intake of pathogenic microorganisms with the contaminated water and food are the main

causes of death. Under this circumstance, probiotics can assist in part the food borne problematic situation, as it is demonstrated in several studies. Shu and Gill, 2000 demonstrated that *B. lactis* can reduce the severity of infection caused by the enterohaemolytic pathogen *Escherichia coli* O157: H7 and suggested that this reduction may be associated with enhanced immune protection conferred by the probiotic. *B. lactis* also demonstrated the ability to provide a significant degree of protection against *Salmonella* infection by enhancing various parameters of immune function that are relevant to the immunological control of salmonellosis (Shu *et al*., 2000). Moreover, the same authors suggested that dietary treatment using *B. lactis* could reduce the severity of weanling diarrhoea associated with rotavirus and *E. coli*, possibly *via* a mechanism of enhanced immune-mediated protection. As a consequence, probiotic treatment might be an effective dietary means of preventing or limiting diarrhoea in human infants (Shu *et al*., 2001). The intestinal barrier maintains the epithelial integrity protecting the organism against bacterial or food antigens that could induce inflammatory processes leading to intestinal disorders such as inflammatory bowel diseases (IBD) (Hooper *et al.,* 2001). *L. casei* ssp. *rhamnosus* has shown to be a promising probiotic in preventing the colonization of the gastrointestinal tract by pathogenic bacteria such as enteropathogenic *E. coli*, enterotoxigenic *E. coli*, and *Klebsiella pneumonia* using in vitro model with Caco-2 cell line (Forestier *et al.,* 2001).

Cultures of lactic acid bacteria, mostly from foods, were tested for their effect on the growth of *Staphylococcus aureus* in Trypticase Soy Broth (BBL). In general, the more effector bacteria there were in the inoculum, the greater was the overall inhibition (or stimulation) of S. *aureus*. Inhibition was most effective at 10 or 15 C, less so at 20 or 25 C, and least at 30 or 37 C, whereas stimulation during early growth was greater at the higher temperatures. Results with different strains of the effectors and with two strains of S. *aureus* were similar, for the most part (Kao and Frazier, 1966).

In the presence of oxygen, LAB produces hydrogen peroxide (H2O2) through electron transport via flavin enzymes. In the presence of H2O2, superoxide anions form destructive hydroxy radicals. This process may lead to peroxidation of membrane lipids (Morris, 1979). The resulting bactericidal effect of these oxygen metabolites has been attributed to their strong oxidizing effect on the bacterial cell as well as destruction of nucleic acids and cell proteins (Piard & Desmazeaud, 1992).

Inoculated pack studies usually found reduced numbers of L. *monocytogenes* after fermentation and drying, however, survivors were also detected. The studies of L. *monocytogenes* survival during fermentation showed several logs decline after the fermentation period of 1 t0 2 days, particularly when starter cultures were used (Farber *et al*., 1993).

Diacetyl is more effective against Gram negative bacteria, yeasts and molds, than against Gram-positive organisms. Diacetyl interferes with arginine utilization by reacting with the arginine binding protein of Gram negative bacteria (Jay, 1996). The growth of salmonella and Staph. *aureus* inhibited when pH decline below 5.3 (Schillinger and Lucke,1989). Decreased pH and water activity-destroys Enterohepatic E.*Coli* (Buchanan and Bagi, 1997).

Effects on composition of milk products

Many of the industrially utilised lactic acid bacteria (LAB) based starter cultures are highly proteolytic. The release of different bioactive peptides from milk proteins through fermentation by LAB is now well documented. It is suggested that some of these benefits can be attributed to biologically active peptides derived from proteins. Peptides are amino acid sequences encrypted within intact protein molecules and are released only upon proteolytic action. Typically, physiologically active peptides can be released during digestion of milk proteins in the gut or during fermentation of milk in the manufacture of yoghurt or cheese (Korhonen and Pihlanto, 2006). Yoghurt bacteria, cheese starter bacteria and commercial probiotic bacteria have been shown to produce different bioactive peptides in milk during fermentation (Gomez-Ruiz *et al*. 2002).

GMP is a C-terminal glycopeptide released from the K-casein molecule by the action of chymosin. GMP is hydrophilic and remains in the whey fraction in the cheese manufacturing process. GMP contains a significant (50-60% of total GMP) carbohydrate fraction which is composed of galactose, N-acetyl-galactosamine and N-neuraminic acid. The non-glycosylated form of GMP is often termed caseinomacropeptide or CMP. Pure GMP can be recovered in large quantities from cheese whey by chromatographic or ultrafiltration techniques. The potential biological activities of GMP have received much attention in recent years. Extensive research has shown that GMP inactivates in vitro microbial toxins of E.*coli* and V. *cholerae*, inhibits in vitro adhesion of carcinogenic bacteria and influenza virus, modulates immune system responses, promotes growth of *Bifidobacteria*, suppresses gastric

hormone activities and regulates blood circulation through antihypertensive and antithrombotic activity (Manso and López-Fandino, 2004).

Many studies have demonstrated that Lactobacillus helveticus strains are capable of releasing antihypertensive peptides, the best known of which are ACE-inhibitory tripeptides Valine-Proline-Proline and Isoleucine-Proline-Proline. The antihypertensive capacity of these peptides has been demonstrated in many in vitro and rat model studies (Nakamura *et al*., 1995).

Milk proteins are considered the most important source of bioactive peptides. Over the last decade a great number of peptide sequences with different bioactivities have been identified in various milk proteins. The best characterised sequences include e.g. antihypertensive, antithrombotic, antimicrobial, antioxidative, immunomodulatory and opioid peptides (Gobbetti *et al*., 2007). Milk derived bioactive peptides may exert a number of physiological effects in vivo on the gastrointestinal, cardiovascular, endocrine, immune, central nervous and other body systems. Bioactive peptides are inactive within the sequence of the parent protein molecule and can be released from precursor proteins in the following ways: (a) enzymatic hydrolysis by digestive enzymes (b) fermentation of milk with proteolytic starter cultures, and (c) proteolysis by enzymes derived from microorganisms or plants. In many studies, a successive treatment by (a) and (b) or (a) and (c), respectively, has proven effective in generating bio functional peptides (Korhonen and Pihlanto, 2007).

Effects on composition of meat products

Peptides and amino acids are present in meat at 1% dry matter basis. Bioactive peptides are produced by lactic acid fermentation and having same effect as described above. PUFA (polyunsaturated fatty acids) is higher than saturated fatty acids in meat products. Feeding formula with long-chain polyunsaturated fatty acids as triacylglycerols or phospholipids influences the distribution of these fatty acids in plasma lipoprotein fractions that is usefull for animal health. Cathepsin D (endogenous protease) is activated at pH values around 5.0 and produces peptides which are then further metabolized by the ripening flora. Later in ageing, bacterial enzymes may also play a role in the degradation of peptides formed (Molley *et al*., 1997).

Other beneficial effects

Exopeptidases from lactobacilli with muscle amino peptidases, generates free amino acids, contributing to flavor. Curing colour develops in acidic conditions. Lactic acids-coagulate soluble meat protein that decreases the water binding capacity leads to drying of the product. Protect from detrimental effects of oxygen (Demeyer, 2000).

Effects on the nutritional value of dairy foods

- Increases folic acid, niacin and riboflavin (yoghurt)
- Vit-B_{12} (cottage cheese)
- Vit-B_6 (chhedar cheese)
- Increases digestibility of protein and fat
- Retention of micronutrients
- Synthesis of probiotic compounds

Effects on nutritional value of meats

- Fermentation creates Omega -3 fatty acids
- Trace mineral GTF chromium

GTF (Glucose Tolerance Factor) Chromium is a safe and absorbable form of the essential trace mineral chromium. Minerals can't be absorbed in their pure state, but have to be bound or chelated to something else. In GTF Chromium, chromium is bound to the B-vitamin niacin. Chromium is needed for the optimal function of the hormone insulin, which regulates energy use, storage and metabolism. Chromium deficiency hampers insulin function and can lead to weight-gain and energy loss

- Proteolysis convert simple peptides into essential amino acids
- Lipolysis increase free fatty acids, essential fatty acids (linoleic, linolenic)

Enhancement of immune system

- Improve immune defence responses by increasing Ig A producing plasma cells
- Short Chain Fatty Acids regulate proliferation and apoptosis of lymphocytes

(Kurita ochiai *et al*., 2003)

- Increase no. of T-lymphocytes & natural killer cells
- Enhance specific and nonspecific immune responses
- Promising effects in immunocompromised patients

Anticarcinogenic activity

- Detoxification, bind with heterocyclic amines

- Decrease activity of glucoronidase, nitroreductase, azoreductase
- Alteration of intestinal environment
- Production of metabolites & inhibitors
- Stimulating the immune system

Effect on Biogenic amines

Histamine, tyramine, phenylethylamine, tryptamine, putrescine and cadaverine are not to be exceed 100mg/kg in the body and are mainly derived from bacterial decarboxylation of amino acids. Putrescine and cadaverine are produced by the Gram-negative spoilage flora. Probiotic cultures inhibit rapidly metabolism of Gram negative bacteria and effectively reduce tyramine levels in fermented sausages.

Probiotics: An edge over Antibiotics

Antibiotics:

- Emergence of antibiotic resistance micro-organisms.
- Unpleasant side effects

Probiotics:

- Non- invasive
- Preventive
- Free from undesirable side effects

Factors affecting Probiotic function

- Type of strain
- Dose and viability of probiotic.
- Viability on the shelf and in the digestive tract.
- Length and frequency of the exposure
- Health and age of the person
- Form of the probiotic taken in

Desirable properties of probiotics

Character	Working	Functional properties
Origin	From same source where it is intended to be used	Species specific health effects and viability in GIT.
Stability	Bile salts and gastric acidity	Survival in GIT
Adherence	To the intestinal mucosa	Immune cell modulation and competitive inhibition of pathogenic organism
Implantation	Positive colonization	Growth and multiplication in GIT
Safety	Well documented clinical safety	Identified as non toxic ,non pathogenic, non allergic,non mutagenic, non carcinogenic
Antagonism	Against pathogenic and putrefactive organisms	Prevention of these organisms from their adhesion to intestinal mucosa
Proven health effects	Clinically documented and validated therapeutic effects	Dose response data for minimum effective dosage of pro. Org. in diff formulation
Stability	Viability during processing and storage	Desirable characteristics maintained, genetically stable, no plasmid transfer
Suitability	Technological suitability	For production of acceptable quality finished products with desirable viable counts

- Presence of prebiotics
- Presence of food in stomach
- Composition of the raw materials
- Processing history of the raw material used as substrate
- Possible interaction of probiotics with the starter cultures
- Processing and storage of the final food products
- Physiologic state of the organism added (either from logarithmic state or from stationary state)
- Packaging by active packaging or MAP
- Maintenance of cold chain
- Homogenous distribution of micro organisms in the product

Stability of probiotics is improved by

- Micro encapsulation - Alginate is a linear heteropolysaccharide extracted from different types of algae, with two structural units consisting of D-mannuronic and L-guluronic acids. Calcium alginate has been widely used for the encapsulation of lactic acid- and probiotic bacteria, mainly in the concentration range of 0.5-4%. Blending alginate with starch is a common practice and it has been shown that encapsulation effectiveness of different bacterial cells especially lactic acid bacteria were improved by applying this method (Jankowski *et al*., 1997).
- Addition of compatible cryoprotectants
- Addition of microbial exopolysaccharides
- Addition of cystein /an oxygen scavenger like ascorbic acid
- Use of oxygen impermeable containers
- Two step fermentations
- Micronutrient incorporation (peptides ,amino acids)

Adverse effects

Their occurrence as normal commensals of the mammalian flora and their established safe use in a diversity of foods and supplement products worldwide supports this conclusion. However, probiotics may theoretically be responsible for three types of side-effects

1. Systemic infections
2. Deleterious metabolic activities
3. Excessive immune stimulation in susceptible individuals

These occurred mainly in very sick patients who received probiotic drugs because of severe medical conditions. Prebiotics exert an osmotic effect in the intestinal lumen and are fermented in the colon. They may induce gaseousness and bloating. Abdominal pain and diarrhea only occur with large doses (Marteau, 2002).

Conclusion

Probiotics are promising healthful dietary ingredients. They may play a role in helping to keep people healthy as well as serve as therapeutic agents for certain conditions.

Probiotic strains of specific species should have specific and well-defined metabolic and functional properties. The probiotic effect should target a particular host function that has been altered through environmental stress, antibiotic utilization, or during specific clinical diseases that result in the alteration of the normal microbiota.

As the industry grows, probiotic products will become more consumer-friendly, with guarantees of product shelf-life, scientifically accurate labeling of contents and truthful descriptions of documented benefits.

Probiotics are extremely sensitive to heat and other processing conditions. New technologies, like microencapsulation and immobilized cell technologies, offer additional protection to probiotic organisms and new ways to include probiotics in foodstuffs.

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