

Original Research Article

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## Analysis of Nitrate Content in Water Samples Collected from Karur Districts Associated With Nitrate Toxicity for Dairy Cattle – A Preliminary Approach

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### ABSTRACT

The present study has been carried out to estimate nitrate content level in water collected from different sources. Approximately, 925 water samples in different sources were collected from Karur districts comprising 8 taluk and selected 4 villages. The nitrate was analyzed from collected water samples by using kit method. The nitrate level analysis is estimated based on the reactions involving acetic acid and Bray's indicator as the coupling agents. The Nitrate level was determined from collected 925 water samples showed that 42.8% samples had 10-50PPM, 31.7% had 51-100 PPM, 1.9% had 101-300PPM, 0.01% had above 300PPM and 1.7% had traces of nitrate content respectively. From the result analysis, it has been suggested that water samples below 100 PPM of nitrate after storing 1 or 2 days should be suitable for the consumption for the dairy cattle. Hence, Laboratory testing of water and feedstuffs is always recommended so that to prevent the nitrate toxicity incidence in cattle.

#### Keywords

Cattle, Nitrate, PPM, Water samples, Methemoglobin

#### Article Info

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### Introduction

Nitrate poisoning occurs commonly in ruminant species due to intake of feed with high nitrate content. Sheep and cattle were more susceptible to poisoning. Generally, nitrates are not toxic to animals but its excess

causes nitrate poisoning (Charlie and Greg, 2015). The ruminant animal fed on nitrate rich forages and it is converted into nitrites and in turn the nitrite is converted into ammonia.

The ammonia is then converted into protein by the bacteria present in the rumen. If the

ruminant animal fed frequently nitrate rich forages over a short period of time, higher level of nitrite accumulated in the rumen. This causes absorption of nitrite by red blood cells and combines with hemoglobin (oxygen-carrying molecule) to form methemoglobin. As a result, methemoglobin incapable of transport oxygen efficiently like hemoglobin which causes respiratory problems and finally leads to fatality. The conversion of hemoglobin to methemoglobin could lead to animal suffer from oxygen starvation. Animals can die within a few hours of the initial ingestion of a high nitrate feed (Crowby, 1985).

In ruminant animals, the conversion of nitrate to nitrite and then changed into ammonia. The excess ammonia is absorbed by the blood stream and passed in the urine as urea. This mechanism generally occurs when the nitrate breakdown system is in balance and no surplus of nitrites accumulates (Barry, 1991). While in monogastric animals such as horses and pigs this type of conversion mechanism occurs, closer to the end of the digestive tract, where there is less opportunity for the nitrites to be absorbed by the blood. The ruminants consumes a high nitrate feed, which led to lack of conversion of nitrate to nitrite and finally to ammonia. This causes excess nitrite to be accumulated in the rumen which intensifies the problem (Christopher, 2010). Thus, ruminant animals were more susceptible than monogastric animals in nitrate poisoning.

Chronic nitrate toxicity is one of the nitrates poisoning where the clinical signs of the diseases are not observed. The common symptoms are reduction in rate of weight gain, lower milk production, depressed appetite, and a greater susceptibility to infections. It also causes abortions within the first 100 days of pregnancy because nitrates interfere with the implantation of the egg in the uterus (Barry, 1991). Reproductive problems may also occur

due to a nitrate or nitrite-induced hormone imbalance, but most are usually not recognized as feed-related. Newborn calves that survive, but are affected by nitrate poisoning, may have convulsions and seizures. Water is one of the significant sources for toxic level of nitrate for livestock. The water from different sources were generally get contaminated by fertilizer, animal wastes or decaying organic matter. Shallow wells with poor casings are susceptible to contamination. Marginally toxic levels of nitrate in water and feed together may cause nitrate toxicity in animals. Hence, it is mandatory to screen nitrate content in water from different sources. Thus in present study, water samples were collected from different sources in karur districts for the estimation analysis of nitrate content to prevent the nitrate toxicity incidence in cattle (Richard and Thomas, 2012).

### **Materials and Methods**

All chemicals used were of analytical reagent grade, and doubly distilled water was used in the preparation of all solutions in the experiments. Hydrochloric acid solution (0.1N HCl) was prepared by 10 ml HCl in 1L Distilled water. Acetic acid (20%) was prepared by 20 ml Acetic acid in 80 ml distilled water. Bray's indicator prepared by 100g barium sulphate ( $\text{BaSO}_4$ ), 10g manganese sulphate ( $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ ), 2g Zinc (metallic Zn), 75g citric acid, 4g sulfanilic acid, 2g 1-naphthylamine are mixed. The bray's indicator is stored in blackened bottle away from light.

### **Sample Collection**

The numbers of water samples were collected based on the propionate random sampling from the Karur districts area. The Karur district area was around 2895.57  $\text{Km}^2$  (Ref). In Karur district, 925 water samples were collected from different villages by using

stratified random sampling/Multi stage random sampling. The source of water samples commonly from Bore Water, Well Water, River Water and Sewage Water were collected for the estimation of Nitrate. Nitrate content was estimated using kit method.

**Nitrate determination**

Nitrate content was estimated by colorimetric method and measured at a wave length of 520nm (Chamandoost *et al.*, 2016). Cattle fed water Samples were taken in 1ml test tube and add 1ml of (20%) acetic acid and 0.5g of Brays indicator for the determination of nitrate. The pink color was observed and compared with score card value. The pink colour formation was due to the reduction of nitrate to nitrite by zinc and manganese sulphate.

The reaction then followed by diazotization of sulfonic acid with nitrate ion and subsequently coupled with 1-naphthylamine to form pink colour.

**Results and Discussion**

**Different sources of water samples collection**

Totally 925 water samples were collected from different sources. Among them, 255 from Well water samples, 247 from Bore Well samples, 100 Bore/Well samples, 181 from River water samples and 142 from Sewage water samples. The different sources of water samples collected were listed in figure-1.

**Nitrate estimation of water samples**

The nitrate content was estimated from different water samples Table-1. The result showed that nitrate concentration found to be varying between samples. Among 925 water samples in Karur district, 42.8% samples had 10-50PPM nitrate content, 31.7% had 51-100 PPM nitrate content, 1.9% had 101-300PPM nitrate content, 0.01% had above 300PPM nitrate content and 1.7% had traces of nitrate content. The results are summarized Table -2.

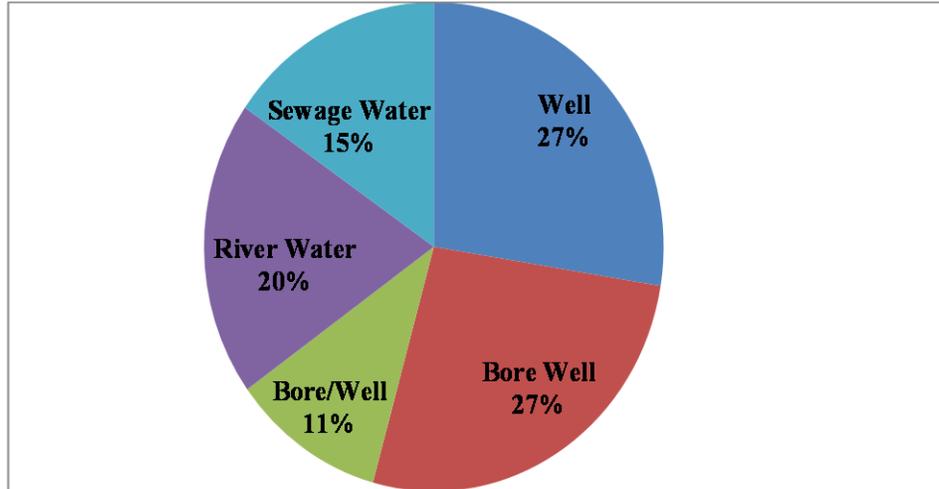
**Table.1** Collection of water samples at Karur Districts

Water Sources	Well	Bore Well	Bore/Well	River Water	Sewage Water
<b>Total=925</b>	255	247	100	181	142

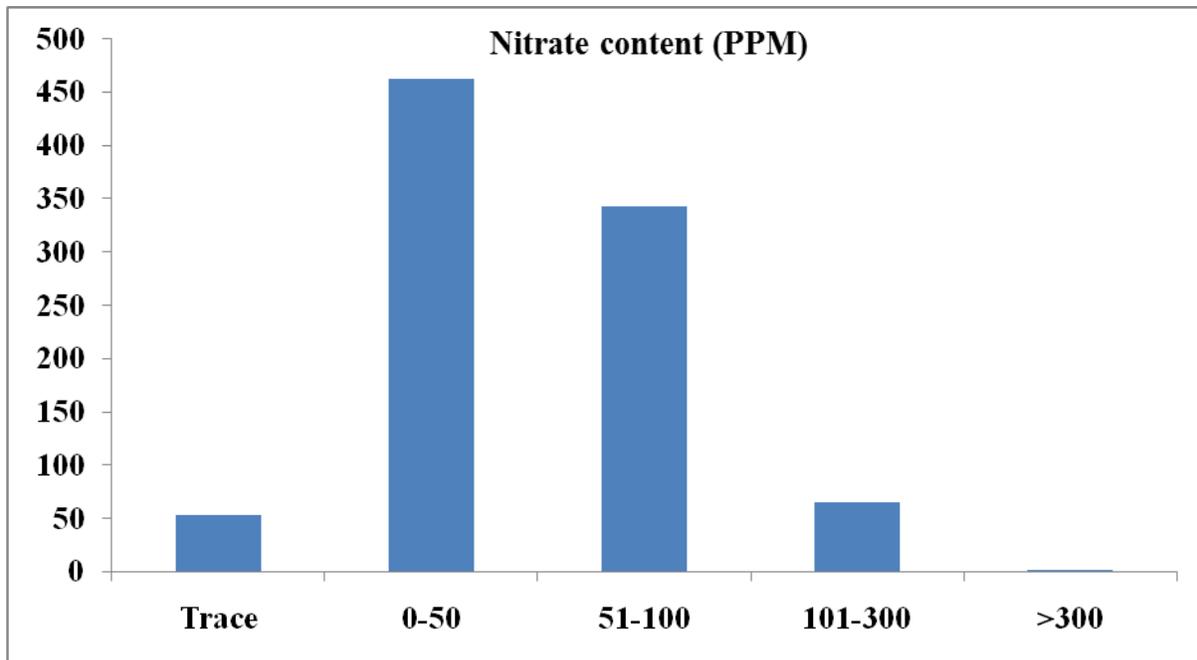
**Table.2** Nitrate estimation of water samples at Karur District

Water Sources	Nitrate content (ppm)				
	Trace	10-50	51-100	101-300	>300
<b>Well</b>	02	173	70	10	--
<b>Bore Well</b>	01	115	118	13	--
<b>Bore/Well</b>	07	23	54	16	--
<b>River Water</b>	42	134	05	--	--
<b>Sewage Water</b>	01	18	96	26	01
<b>Total</b>	<b>53</b>	<b>463</b>	<b>343</b>	<b>65</b>	<b>01</b>

**Fig.1** Collection of water samples in Karur Districts



**Fig.2** Nitrate estimation of water samples in Karur District



Water samples which had >100 PPM nitrate content has related with incidences of nitrate toxicity and death of dairy animal (Richard and Thomas, 2012). The water gets high risk source of nitrates through water from deep wells fed by soil water from highly fertile soils, condensed water from ventilating shafts in piggeries due to higher ammonia levels in the air, fluids draining from silos containing

materials which is rich in nitrates and water contaminated by fertilizer, animal wastes or decaying organic matter may also be a source of toxic levels of nitrate. Marginally toxic level of nitrate present in water and feed when combined to give cattle can also lead to poisoning. Livestock breeding could also affect consuming water samples above 100PPM nitrate content (Crowby, 1985).

Hence in present study, very few samples were recorded above 100PPM nitrate content. This might be due to that source of water from ponds, shallow wells or streams that collect drainage from manure, highly fertilized fields or industrial waste. Deep wells are usually safe sources of water (Provin and Pitt, 2012). In this study bore well/well collected from different sites were found to be predominantly below 100 PPM which illustrates that bore well waters are usually safe sources of water. These waters should be safe for livestock and prevent nitrate poisoning.

Hence, it can be concluded that nitrate estimation is necessary in different water samples where the farmer following indiscriminate use of fertilizers or excess application of urea/poultry manure to the field, so that to prevent the nitrate toxicity incidence in cattle.

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