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PERCEPTION OF FARMERS, FEED PROCESSORS AND FEED RETAILERS ON CONTAMINANTS OF LIVESTOCK FEED AND WATER IN SOME SELECTED AREAS OF ETHIOPIA

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Abstract: *The study was undertaken in Western, Eastern and Southern Shoa Ethiopia with the aim of assessing the handling and storage practices of feeds and risks related to livestock water along the feed production, marketing and utilization chain. A total of 180 individuals (feed processors=33, feed retailers=51, smallholder dairy producers=96) participated in the study. Because of improper harvesting and stacking, 91% of farmers encountered mold in roughage feeds. Most of the farmers provide light-moldy feeds to livestock by mixing with uncontaminated ones. About 67% and 33% of the interviewed farmers utilized extreme moldy feeds for firewood and damping respectively. Farmers perceived industrial effluent and leech to be as a safety risk to livestock water. All the interviewed farmers from Eastern Shoa were aware of industrial effluents as a problem for dairy production; and 66% and 34% of the respondents from Eastern and Western Shoa respectively identified leech to be a safety problem to livestock water. About 69% of the farmers used bucket for scooping from water bodies to exclude leech from being consumed by animals; and 50% of them treated animals with chopped tobacco and onion as indigenous knowledge. Feed processors=64%, feed retailers=82% and dairy producers=56% did not store their feed on raised floor indicating that there is probability of mold formation in stored feeds. About 67% of the feed processors, 73% feed retailers and 58% of the dairy producers stored concentrate feeds for shorter period of time (1 month).*

Keywords*: Concentrate feed, dairy producers, questionnaire, storage time, value chain.*

1. Introduction

In Ethiopian agriculture, livestock has a 40% share of agricultural production and contributes to 13-16% of the total Gross Domestic Product (GDP) [1]. At household level, livestock production has become important for the livelihood of pastoralists, agro-pastoralists, and smallholder farmers [2].

The economic benefits gained from export of livestock and livestock products in 2015/2016 were estimated at 37.5 million US dollar [3]. Although the country poses the highest number of livestock species in Africa, the annual per capita consumption of milk in 1996 for example was of 17 kg which was lower than that of per capita milk consumption of other South and Central African countries and developed countries which was of 26 kg and 200 kg respectively [4].

Despite some improvements on export of livestock and livestock products in recent years, productivity and commercialization of the livestock sub-sector is still very low

[2] [5].This is because livestock production is mainly undertaken by small-holding rural producers and pastoralists using inefficient local breeds depending on poor quality pastures and lack of veterinary services [4]. Moreover, the peri-urban and urban livestock production system is suffering from inadequate supply of animal feeds due to the underdeveloped agri-food chain and other structural problems [4].

Livestock production in the country is mainly dependent upon basal roughage feeds resources including natural pasture, hay and crop residues whereas peri-urban and urban dairy producers use supplemental feed including agro-industrial by-products such as wheat bran, noug seed meal, linseed meal, cottonseed meal and non-conventional concentrate feeds such as poultry liter and home produced by products of cereals and pulses (Rehrahie, unpublished data).

For many years now, a lot of attention has been given to increase the quantity of feed through research in Ethiopia [6] [7], However, there is a dearth of information on the quality and safety status of feed stuffs that determine the quality, safety of livestock products (milk, meat and egg). The ever-growing movement of food through international trade also necessitates guarantying the quality and safety of imported, exported and locally produced food products [8].

The main factors that affect feed and food safety is categorized into biological, chemical and physical contaminants [9]. Feed and water sources are contaminated with chemicals such as heavy metals, and toxins and compromise the quality and safety of dairy products through the food chain. The biological contaminants, mainly the filamentous Fungi grow on agricultural products and cause postharvest deterioration in cereals, oilseeds and legumes and by producing the chemical byproducts known as mycotoxins [10].

The fungus that is grown in the field is further flourish at harvest, storage and processing [11] [12]. Under optimum condition (moisture of > 13% and temperature of 40^0F-100^0F), mold spores germinate, increase in number and consequently utilize the nutrients in grains and feeds and can reduce the nutritional quality of grains and feeds [13]. [14] reported that storage fungi had adverse impact in reducing the carbohydrate content of sorghum grain in Eastern Harerghie, Ethiopia. Apart from that, supply of moldy feeds results in reduced digestibility [13], reduced feed intake, nutrient intake, weight gains and milk production [15]. A production performance lose of 5-10% was also observed with feeding moldy feeds to livestock even in the absence of mycotoxins [13].

There are different stakeholders in the value chain of dairy production systems which include small-scale peasant farmers, peri-urban and urban milk producers, feed processors, and distributors. The experience and indigenous knowledge of these partners, together with the monitoring and quantitative analysis of physical, chemical, and biological contaminants, is very vital to improve the handling and management of feeds in order to ensure the safety of dairy products. Such studies can be used as benchmarks to scale up dairy production in the country. In this study attempt was made to assess feed storage practices, and problems associated with safety of feeds and water on livestock species based on the experiences and perception of stakeholders including feed processers, feed retailers, smallholder urban dairy producers and farmers.

2. Materials and Methods

2.1. Study location

The study was carried out in Western shoa (Welmera/Holetta), Addis Ababa, Eastern Shoa (Akaki, Gelan and Ada) and Hawassa. Addis Ababa and Holetta are located at 38° 30`E, 9° 3`N. Ada and Hawassa are located in the Great Rift Valley at latitude of $8^{O}50$ to $8^{O}53$ and longitude of $38^{O}55$ to $38^{O}59$ at an altitude of 1708 m.a.s.l and 1600-2400 m.a.s.l respectively. Hawassa is located 285 km of Addis Ababa, South Ethiopia. The average annual rainfall was 1100 mm and average low and high temperature of 12.6 ^{o}c and 27.3 ^{o}c respectively [16].
Map of the study locatons are indicated in Fig. 1, 2 ,3 and 4.

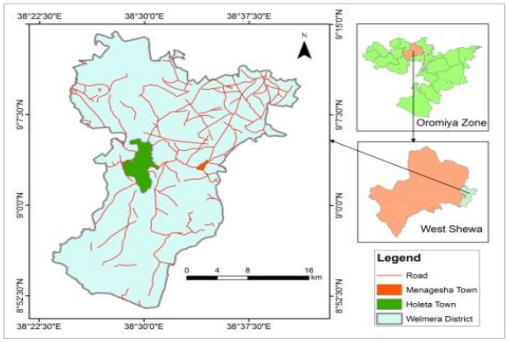

Fig 1. Map of Holetta in Western Shoa

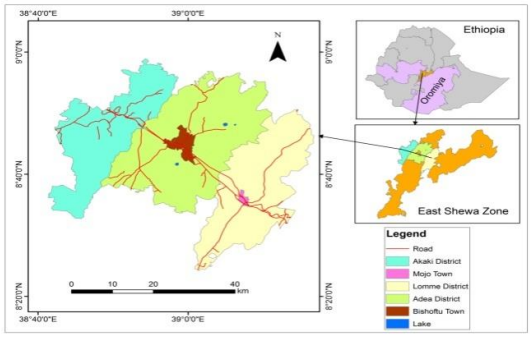

Fig 2. Map of Bishoftu in Eastern Shoa

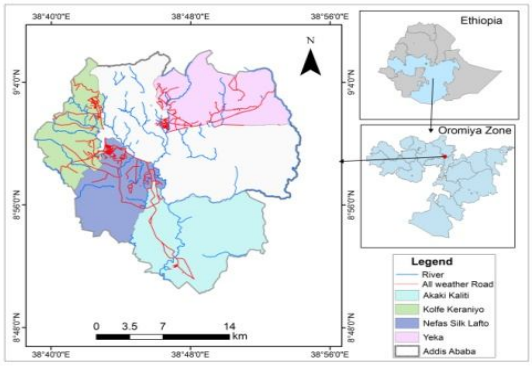

Fig 3. Map of Addis Ababa

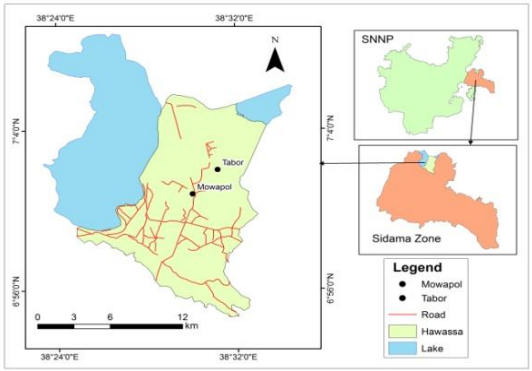

Fig 4. Map of Hawassa

2.2. Data collection and analysis

The study was conducted using a semi-structured questionnaire involving a total of 180 feed processors, feed retailers, urban smallholder dairy producers and rural farmers in Central Ethiopia (Welmera, Addis Ababa, Akaki, Gelan, Ada and Hawassa) on feed storage methods and observed risks on livestock species that have been exposed to contaminated feeds and water. The collected data (qualitative) were organized and analyzed using descriptive statistics available in IBM [17].

3. Results and discussions

3.1. Problems of mold in animal feeds

The experiences of farmers on occurrence of moldy feeds, suitable seasons for mold formation and risks of moldy feeds to livestock species are presented in table 1. According to the interviewed respondents 91% (78) of them recognized the presence of mold problem mainly in roughage feeds including crop residues and hay. According to these respondents, mold formation occurred mainly during the rainy season or when roughage feeds are stacked in the absence of proper drying during harvest or because of bad baling style that can promote transfer of rain water.

Table 1

Response of farmers on occurrence of mold in feeds, severe moldy season and problems of moldy feeds to livestock

Suitable season for mold formation	Farmer's response		Problems of moldy feeds to livestock	Farmer's response		Management of moldy foods	Farmer's response	
	N	%		N	%		N	%
Rainy season	32	100	Illness	52	59	Damping	9	33
Dry season	0	0	Feed rejection	22	25	Firewood	18	67
Total	32	100	Abortion	13	15	Total	27	100
			Death	1	1			
			Total	88	100			

Those farmers who encountered mold in their feeds admitted that they provide lightly contaminated moldy feeds with livestock species by mixing them with fresh feeds which is in agreement with the practices employed in many countries [18]. However, 33% of the interviewed farmers completely discarded/dumped the extremely moldy feeds in landfills, and 67% of the respondents used moldy feeds for firewood implying that farmers have recognized the disadvantage of feeding moldy feeds to livestock species. In the situations when animals were fed with moldy feeds, farmers observed problems with their livestock such as illness (59%), feed rejection (25%), abortion (15%) and death (1%). The observation of farmers was similar to the bad effect of mold indicated in [19] where feed rejection and reduced feed intake were some of the associated problems of moldy feeds to livestock species. It was also reported that moldy feeds affected the production performance of cattle because of deterioration of nutrients in the mold contaminated feeds. Apart from any toxin effects, the mold itself caused production losses [20]. Livestock producers in Minoseta reported that the animals given mold contaminated feeds encountered health problems such as reduced feed intake, diarrhea, reduced weight gain, abortions or death [20].

3.2. Farmers' perception on causes and effects of contaminated water

The experience of farmers in relation to the causes and effects of contamination/ pollution of livestock water is presented in table 2. Accordingly, the majority (80%) of the interviewed farmers had knowledge on contamination of livestock water with undesirable substances and parasites in their surroundings and recognized the two major contaminants of livestock water. One of them was the effluents discharged from industries particularly in Eastern Shoa, and the other was the problem of the parasitic leech (*Lymnatis nilotica*) that naturally infest water sources during dry season which was commonly observed in

Eastern and Western Shoa. It was reported that scarcity and poor quality of water in relation to leech infestation was reported by farmers as third most important problems (27%) of livestock production in Dendi area, Ethiopia next to feed and animal diseases [21]. High prevalence of leech infestation was observed in the dry season because of reduced flow, quantity and run of water into water sources as well as because of washing and bathing closer to livestock watering points [21]. Report from interview of farmers in Sodo district SNNP, also revealed that 95% of the respondents rated leech as a major animal health problem [22]. Whereas, in Northern Ethiopia, Alamata, infestation of livestock water with Leech was identified as a last risk among the major cattle health problems and verified, leech, as blood sucking parasite attach the pharynx part of the oral cavity while animals drink water and was responsible for loose of large amount of blood within short period of time resulting in anemia [23]. [24] in Libya also reported the exposure of different livestock species to leech infestation with increased rate observed in cattle [24].

Table 2

Farmer's perception on causes and risks of contaminated water

Causes of water contamination by location	**Farmers' response**	**Risks related to effluent contaminated water**	**Farmers' response**		**Risks related to leech contaminated water**	**Farmers' response**	
	%		No	%		No	%
Leech in Holetta	34	Diaharrea	6	20	illness and water rejection	37	76
Leech in Bishoftu	66	Bad smell, water rejection, skin itching & emaciation	22	73	Death	8	16
Effluent in Holetta	0	Coughing	2	7	Milk reduction	4	8
Effluent in Bishoftu	100	Total	30	100	Total	49	100

Almost all of the interviewed farmers from Eastern Shoa have observed the effluents released from different factories in the surrounding water bodies that have become a risk to health of livestock species. About 66% of the interviewed farmers from Eastern Shoa admitted that the parasite leech (*Lymnatis nilotica*) was the second important parasite in livestock water. However, the interviewed farmers from Holetta did not mention pollution of water because of effluents released from factories; but 34% of the respondents from Holetta identified that leech was the major contaminant of livestock water.

Almost all of the farmers in Eastern Shoa had the perception of the different risks related to drinking of effluent contaminated water to livestock species, and 73% of them associated the contamination with commonly observed problems of bad smell, water rejection, emaciation and skin itching, followed by diarrhea (20%) and coughing (7%). Likewise, the majority (76%) of the farmers in both locations agreed that

illness (nose bleeding), reduced body weight and water rejection were commonly associated with leech contamination of water followed by death (16%) and milk reduction (8%). The health problems mentioned by the interviewed farmers in the present study was similar to the reports of [25] in that bleeding and reduced appetites were the commonly observed problems in cows which consumed leech contaminated water in Iran.

3.3. Indigenous practices employed to overcome leech infested water

The farmers also had the traditional knowledge and experience of applying different traditional practices to control contamination of Leech in water bodies and mouth of the animal (Table 3). Among the interviewed farmers the highest proportion (69%) of them used bucket for selectively scooping water from the water body and excluding the ingestion of Leech by the animals. Farmers also employed immersion of Endod in water bodies as a second (13%) important leech minimizing practice. This was scientifically proved by a study undertaken in Sodo, Guragie zone of Ethiopia, in that application of Endod (*Phytolacca dodecandra)* in water bodies resulted in 97-100% reduction in streams used for livestock drinking [22].

Farmers also practiced different strategies to remove leech from the mouth of animals of which 50% of them used to drench chopped tobacco and or onion to livestock species. According to the respondents, 32% of them physically removed the leech from the animal by hand which was similar to the practices and experience of leech removal employed in Iran [25]. In this study, 10% and 8% of the respondents respectively solved the problem by drenching tablet and restriction of animals from drinking water for one day to facilitate release of leech in the mouth of the animal so as to be able easier to remove it from the mouth. To prevent contamination of livestock water with leech, the farmers in West Shoa (Dendi), Ethiopia employed different practices such as separating human and livestock water points, washing and bathing areas and fencing livestock water points [21].

Table 3

Indigenous practices to overcome leech infested water

Practice to prevent leech from being consumed by animals	**%**	**Practice to kill leech entered in animal body**	**%**
Immersion of stalk of noug and linseed	6	Drenching chopped Tobacco and/or onion	50
Immersion of Endod (*Phytolacca dodecandra*)	13	Drenching tablet	10
Bucket watering	69	Withdrawal of water	8
Use of other alternative water sources	12	Taking away from mouth	32
Total	100	Total	100

3.4. Storage methods of concentrate feeds in feed processing factories

In this study, different stakeholders involved in the feed production, marketing and utilization chain were interviewed to evaluate the storage methods of concentrate feeds. Accordingly, the majority of the feed manufacturers (64%) stored their concentrate feed on cement floor without using palate (table 4). Palate is any material (minimum of 50 cm height) placed on a floor over which concentrate feed is stored to avoid contact between the

concentrate feed and the floor to minimize the transfer of moisture.

It was observed that some feed manufacturers left some space between two adjacent stored concentrate feeds and between the stored feed and the wall and the roof to allow ventilation implying that they have good understanding of benefit of air circulation in stored feeds. They have similar understanding with people in developed countries in that grain storage facilities in the U.S. have fans installed for ventilation and temperature control in the stored grain [15].

Table 4

Storage methods of concentrate feeds in feed processing factories (% and n)

Storage method	Study location			
	Holetta	**Bishoftu**	**Hawassa**	**Total**
On cement floor with no palate	61 (11)	50 (3)	78 (7)	64 (21)
On cement floor with palate	33 (6)	17 (1)	11 (1)	24 (8)
On soil floor with no palate	0 (0)	17 (1)	0 (0)	3 (1)
On soil floor with palate	6 (1)	0 (0)	0 (0)	3 (1)
Missing	0 (0)	17 (1)	11 (1)	6 (2)
Total	100 (18)	100 (6)	100 (9)	100 (33)

Consecutive figures in each cell are percent and number of respondents respectively

Among the interviewed feed manufacturers in this study, the majority (72%) of them preferred using palate to store only wheat flour whereas, 28% of the interviewees used palate equally for both wheat flour and wheat bran.

3.5. Storage duration of concentrate feeds in feed manufacturers

The storage duration of concentrate feeds by feed manufacturers is presented in table 5. Accordingly, the majority (67%) of the interviewed feed manufacturers stored their concentrate feeds for shorter duration (a maximum of 1 month) which is related to the higher market demand for concentrate feeds in the country. The result also showed that 24 % of the feed manufacturers kept their concentrate feed for duration of 6-8 months, particularly during the rainy seasons when alternative feed resources such as green grass were available and resulting in decreased market demand and increased storage time of concentrate feeds.

Table 5

Storage duration of concentrate feeds in feed manufacturers (% and n)

Storage duration (month)	Study location			
	Holetta	**Bishoftu**	**Hawassa**	**Total**
1	61 (11)	50 (3)	89 (8)	67 (22)
2 - 3	6 (1)	0 (0)	0 (0)	3 (1)
4 - 6	6 (1)	0 (0)	0 (0)	3 (1)
6 - 8	28 (5)	33 (2)	11 (1)	24 (8)
Missing	0 (0)	17 (1)	0 (0)	3 (1)
Total	100 (18)	100 (6)	100 (9)	100 (33)

Consecutive figures in each cell are percent (%) and number of respondents (n) respectively

3.6. Storage methods of concentrate feeds in feed retailers

The storage style of concentrate feeds in feed retailers is presented in table 6. The majority of the feed retailers (82%) in the study locations stored their concentrate feed on cement floor without using palate. The situation was worse than that of feed manufacturers and feed processors where 64% of the owners stored their concentrate feed on cement floor without using palate. Among these feed retailers the majority were in Hawassa (93%) followed by Holetta (84%) and Bishoftu (71%).

Table 6

Storage methods of concentrate feeds in feed retailers (% and n)

	Study location			
Feed storage styles	**Holetta**	**Bishoftu**	**Hawassa**	**Total**
On cement floor with no palate	84 (16)	71 (12)	93 (14)	82 (42)
On cement floor with palate	5 (1)	6 (1)	0 (0)	4 (2)
On soil floor with no palate	0 (0)	24 (4)	7 (1)	10 (5)
On soil floor with palate	5 (1)	0 (0)	0 (0)	2 (1)
Missing	5 (1)	0 (0)	0 (0)	2 (1)
Total	100 (19)	100 (17)	100 (15)	100 (51)

Consecutive figures in each cell are percent (%) and number of respondents (n) respectively

3.7. Storage duration of concentrate feeds in feed retailers

The storage durations of concentrate feeds in feed retailers is shown in table 7. The majority of them (73%) in the study locations on average stored their feed for a shorter period of time (1 month). This was because of the higher demand of concentrate feeds by livestock producers. The feed retailers that stored their concentrate feeds for very short duration of time (1 month) was lower in Holetta (47%) than the feed retailers from Bishoftu (82%) and Hawassa (93%).

Table 7

Storage duration of concentrate feeds in feed retailers (% and n)

Feed storage duration (month)	**Study location**			
	Holetta	**Bishoftu**	**Hawassa**	**Total**
1	47 (9)	82 (14)	93 (14)	73 (37)
1 - 2	0 (0)	6 (1)	0 (0)	2 (1)
2 – 3	5 (1)	0 (0)	0 (0)	2 (1)
Missing	47 (9)	12 (2)	7 (1)	24 (12)
Total	100 (19)	100 (17)	100 (15)	100 (51)

Consecutive figures in each cell are percent (%) and number of respondents (n) respectively

3.8. Storage methods of concentrate feed in dairy producers

The storage methods of concentrate feeds in smallholder dairy producers is shown in table 8. The majority (56%) of the smallholder dairy producers stored on cemented floor with no palate, followed by 16% of the dairy producers that stored their feed on soil floor lined with certain sheet such as plastic or cloth of which the majority were dairy producers from Holetta (27%).

Majority of the dairy producers from Bishoftu (76%) and Hawassa (73%) stored their concentrate feeds on cemented floor without palate. The present study has also shown that 64% of the feed processor (table 5.4), 82% of feed retailers (table 7) and 56% of dairy producers (table 9) have not used palate for placing their

concentrate feeds indicating, there is probability of mold formation in stored concentrate feeds.

Although no information was available showing the bad effect of the traditional storage and handling methods of livestock feeds in Ethiopia and abroad, few survey studies were conducted in the country to evaluate traditional grain storage practices and structures (differing from region to region) on nutrient quality of cereal grains. Accordingly, storing sorghum for longer duration deteriorated the nutritional composition [14]; [26]. About 16% lose in grains (by weight) in the pastoralist areas of Ethiopia were also recorded because of deteriorations in nutrient composition of stored sorghum in relation to mold contamination [27]. According to [28], quality and nutrient deterioration was observed in stored maize in farmers employing traditional grain storage practices. The author identified mold and insects to be the two major factors causing nutrient deterioration in grains and observed moisture and temperature as ideal medium for mold growth. According to [29], 50% loss in the yield of sorghum grain was recorded because of insect pests in South Western Ethiopia.

Table 8

Storage methods of concentrate feed in dairy producers (% and n)

Feed storage methods	Study location			
	Holetta	Bishoftu	Hawassa	Total
On cemented floor with no palate	21 (7)	76 (25)	73 (22)	56 (54)
On cemented floor with palate	0 (0)	0 (0)	10 (3)	3 (3)
On soil floor with no palate	3 (1)	15 (5)	7 (2)	8 (8)
On soil floor lined with certain sheet	27 (9)	9 (3)	10(3)	16 (15)
Missing	49 (16)	0 (0)	0 (0)	17 (16)
Total	100 (33)	100 (33)	100 (30)	100 (96)

Consecutive figures in each cell are percent (%) and number of respondents (n) respectively

3.9. Storage duration of concentrate feeds in dairy producers

The storage durations of concentrate feeds in smallholder dairy producers is presented in table 9. Due to increased price of concentrate feeds these days, the majority of dairy producers (58%) stored their concentrate feed for a shorter period of about 1-2 weeks.

Table 9

Storage duration of concentrate feeds in dairy producers (% and n)

Storage duration (week)	Study location			
	Holetta	Bishoftu	Hawassa	Total
1	0 (0)	0 (0)	25 (10)	10 (10)
1 - 2	30 (10)	33 (11)	40 (16)	58 (37)
3 - 4	24 (8)	42 (14)	20 (8)	12 (30)
Missing	46 (15)	24 (8)	15 (6)	31 (29)
Total	100 (33)	100 (33)	100 (40)	100 (106)

Consecutive figures in each cell are percent (%) and number of respondents (n) respectively

4. Conclusions

In this study, the majority of farmers had the knowledge on the occurrence, causes and effects of mold in feeds and, farmers dwelling in the industrial zone of Eastern Shoa mainly in Gelan area were aware of the pollution problems of livestock water

caused by released effluents from different factories. They were also aware of leech problem in livestock water use, and some also had indigenous knowledge on how to protect and treat their livestock from the scourge of the leech. Under these circumstances, they were also conscious of the pollution problems on the health and productivity of their livestock.The majority of the dairy producers, feed retailers and feed manufacturers did not use palate to store concentrate feed indicating that there was the possibility of mold occurrence in concentrate feeds. Further research needs to be undertaken along the feed production, processing, marketing and utilization chain, on the effects of different storage conditions by considering factors such as use of palate, ventilation and time of feed storage on mold formation and nutrient quality of feeds using larger sample size.

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