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Research Paper

Veterinary dosage forms

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ABSTRACT

In the field of science known as veterinary medicine, non-human animals such as cattle, working animals, and domestic animals are treated using medical, surgical, public health, dental, diagnostic, and therapeutic concepts. The development of veterinary dosage forms holds promise for the future of biotechnology, medication therapy, and diagnostics. Brief explanations of the classification of animals, the requirement for veterinary dosage forms, the flavorings used in animals, the various routes of administration, and the dosage form in animals are the main points of this overview. A brief discussion has been had on stability studies and control agencies from various nations that concentrate on the legal requirements for veterinary pharmaceuticals.

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1. INTRODUCTION

Pharmaceutical preparations known as veterinary dosage forms are meant for use or topical application to one or more domestic animal species as well as other species of veterinary interest. Some veterinary preparations contain medications that are not frequently used in people, despite the fact that most veterinary dosage forms contain the same medication as human dosage forms [1]. When compared

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to human pharmacology, veterinary pharmacology is more diverse in terms of species and places a greater emphasis on particular medication classes. Certain dose formulations can be used on both humans and specific animal species [2].

To meet this diverse need, veterinary medicinal products can be manufactured in a variety of forms including

1. Tablets, Boluses
2. Capsules
3. Feed additives
4. Drinking water medications
5. Parenteral dosage form
6. Oral pastes and gels.
7. Drenches and tubing products
8. Topical Products
9. Veterinary vaccines.

1.1 Tablets and Boluses

One of the most popular ways to give humans medication is through solid dosage forms, such compressed pills. These animals are less common since administering medication to them can be time-consuming, risky, and unsafe because you can't be sure the tablet won't be ingested, spat out, or slip out of the mouth once the dispenser has left or been passed to another animal [3].

Tablets that the animal voluntarily accepts are often chewed, revealing the unpleasant design of some medications. As a result, the benefit of the dose form may be lost. In some circumstances, using flavours, sweets, or perfumes can help to overcome this. Tablets can be coated to distinguish the product colour, to lessen flavor-impairing substances, or to avoid dusting in the bottle.

Whether for mammals, avian creatures, or humans, medications are given based on body weight or body surface area. Large mammals like cows and horses require a certain dosage of medication, which is often measured in mg or g of tablet per pound (kg) of body weight. Sulfonamides are one type of drug that is commonly prescribed in relatively high doses; a 750-pound cow or horse would receive 75 grams of medication, which is up to 15 grams every 150 pounds of body weight. The recommended dose of levamisole for the eradication of the above mentioned infestations in cattle, sheep, and cattle is 7.5 mg/kg body weight. Goat Levamisole hydrochloric acid BP 300mg Balling/Bolus Gun 27grams Copper and 500 milligrams slow-release, long-acting intra-ruminal bolus and selenium for routine supplement for cows [4].

Delivering extremely huge amounts typically involves the use of a unique pill known as a "bolus." A bolus, which can weigh anywhere between 3 and 16g or more, is just an extremely large pill. Boluses are cylindrical or capsule-shaped due to a circular bolus would be challenging to administer or swallow. A tool known as a ball gun is used to inject boluses. It is difficult to create boluses because of the high medication to excipient ratio. Diluents, binders, and other adjuvants that mask unfavourable drug characteristics or make bolus preparation easier have less room. It is feasible to employ the idea of sustained release boluses in ruminants like cattle or sheep that remain in the digestive track for periods greater than 12 hours. This is due to the fact that solid things can last eternally in the ruminoreticular sac, a section of the digestive system of cattle. The most important component in pouch retention is bolus density. For lengthy retention, it is thought that densities in the range of 1.5 to 8.0 are preferable. Adjuvants including iron, clay, sodium sulphate dihydrate, and dicalcium sulphate are used into these formulations to achieve this. Density has a greater impact on retention than weight or size. There are still instances where a pet's mouth must be opened so that a medication can be given through a "pill," or tube with a plunger [5].

1.2 Capsule

There are certain livestock vitamin and mineral supplement capsules accessible here, despite the fact that the capsules are often used for dogs and cats. Nutraceuticals, vitamins and minerals, and antimicrobials are the three primary therapeutic areas where capsules are used as a dose form. For veterinary treatment, the standard gelatin capsules are adaptable. Fascinatingly, to encourage dogs and

cats to ingest the items, the manufacture of Capsuline for Dogs and Cats adds flavours to the shells like beef, chicken, or bacon. For use by cattle during calving, transportation, and medical treatment, A yeast/microbial supplement called Rumacin Cattle Capsule is enhanced with 6 grammes of niacin, B vitamins, and digestive enzymes. Niacin in high concentrations that are scientifically shown to help rumen microorganisms and regulate ketosis.

- **Feed Additives (Premix):** In veterinary medicine, feed additives are substances that are added to feed or water to deliver active compounds to animals. The feed ingredient, commonly called a premix, can be either solid or liquid. There are three categories for feed additives.
- **Type A Medicated Feeds:** These medicated products contain one or more active substances derived from animals that are intended to be further mixed with feed or water before being consumed by animals. These treatments are not considered dosage forms because they are not administered to animals.
- **Type B Medicated Feed:** Type B medicated feed refers to products that contain a type A medicated feed or another type B medicated feed as well as a sufficient number of nutrients. Type B medicated feeds, like Type A medicinal goods, are not intended for oral administration to animals and should not be considered dosage forms. They are intended to be mixed with other feed or with additional water and minerals.
- **Type C Medicated Feed:** Produced in API concentrations acceptable for administration to animals by mixing with food or water, Type C medicated feed is made from Type A or Type B medicated feed. The administration of type C medicated feeds can be accomplished in one of three ways: by mixing them directly with the feed; by seasoning the preparation to the animal's regular daily rations; or by heating, steaming, and extruding the preparation into pellets that are mixed or flavour with the feed. Pressed or moulded blocks are another type of Type C medicated feed, and animals consume the block's nutrients or active ingredient by licking it.

1.3 Preparation

Making liquid type A pharmaceuticals requires combining APIs with the right solvent (e.g. water or propylene glycol). APIs can also be produced as suspension products; however, APIs are often dissolved to create a solution. Manufacturing solid medicinal products involves combining the active component with excipients to create a consistent dose form that can be added to the animal's diet. It is frequently first coupled with an excipient that has a particle size similar to the API and can help disperse the API throughout the finished medicinal product. This premix is next blended with additives like calcium carbonate or soy bean hulls. When producing type B or type C medicated feed, mineral oil can be used to help with uniform distribution, prevent particle segregation during shipping, and minimise the development of airborne API particles. Type B or Type C feeds are produced by licenced feed mills or by farmers. In order to create feeds, type A medicinal compounds are added to feeds during the grinding process. Frequently, solid type A medications are combined to liquid type medicines that are dispersed in fixed amounts and type A medicines are added to achieve a uniform distribution in food.

1.4 Labelling and Packaging

Medicated feed of type B or items of type A are identified by a special label that specifies whether they should be used to manufacture animal feed or water. On the label, it is stated that they shouldn't be given directly to animals. Not for human use is stated in the disclaimer as well. Medications of type A or type B are either packaged as liquids in plastic bottles or as solids in paper bags, typically with a polyethylene liner. Sizes that are usual include 50-pound bags or multi-gallon containers. Additionally, while it is used every day to make the final feeds, the medicated feed must be for several months. Storage may occur outdoors under the sun and rain or in warm, humid grain storage can cause further problems.

1.5 Drinking Water Medications

To ensure that the marketed product does not precipitate when subjected to abrupt changes in temperature and pH, a thorough grasp of how pH and temperature affect solubility is necessary. The next

step is to look at a co-solvent system if water is unable to solubilize the medication. Ethanol, propylene glycol, glycerin, and triacetin are among the possible vehicles. These can be employed separately or in combination to create a system that is really non-aqueous.

Co-solvents with oil carriers may be employed in specific circumstances to solubilize the medication. Pharmaceuticals are designed as either (a) dry powders that must be reconstituted into liquid concentrations before being added to or injected directly into drinking water, or (b) concentrated solutions that must be injected into drinking water from dispensers integrated into irrigation lines.

The benefit of treating sick or diseased animals with drinking water as opposed to food is that they can continue to drink while they may not be able to eat. The concentration of the active substance in the water should only be half that in the food because animals drink twice as much water as they do food. Using automated dosing technology or pharmaceutical ratios, many animals are treated. When given, the powdered medication is dissolved in water to make a stock solution, which is dosed into the drinking water system when the animals drink the water.

With the US, a one fluid ounce per gallon dilution of stock solution is commonly made by diluting it in 127 ounces of water. Whether a product is created as a dry powder, dispensing tablet, or liquid concentrate, the consequences of the water dilution medium's properties must be taken into consideration by the product development/mixing pharmacist.

1.6 Conditions of Use

The stability of the medicinal product in drinking water must be adequate for the labelled storage time. When producing a liquid concentrate with a solvent other than water, it is also important to take into account the likelihood of the medication precipitating or recrystallizing after being diluted with water. The aforementioned elements make it an intriguing and difficult undertaking to formulate drinking water solutions for animals.

1.7 Parenteral Dosage Forms

Injections, intramammary infusions, intravaginal delivery methods, and implants are examples of parenteral dosage forms and delivery systems. Injections also include solutions, suspensions, emulsions, and dry powders for reconstitution.

- A solution for injection is the fusion of two or more compounds into a single, molecularly homogeneous phase. "Water for Injections" is the parenteral formulation solvent that is most frequently utilized..
- Injectable suspensions are made up of insoluble solid particles that range in size from 0.5 to 30% and are spread throughout a liquid media. The medium may be both watery and oily. Suspensions for injection are frequently utilized.
- An injectable emulsion is a heterogeneous dispersion of one immiscible liquid in another, and it is stabilised by the presence of an emulsifier. Parenteral emulsions are uncommon since it is seldom necessary to make an emulsion for the delivery of medications.
- Just prior to injection, a parenterally administered dry powder is reconstituted as a solution or suspension. This dose form's primary advantage is that it addresses the problem of solution instability.
- Mastitis Products for intra-mammary infusion can be used in both lactating and non-lactating (dry) cows. Intramammary infusions for nursing cows should have less binding to the udder tissue and a rapid, even diffusion of the active ingredient. As a result of these traits, drug residue levels in milk are decreased.

1.8 Oral Pastes and Gels

Pastes and gels are semi-liquid masses that can be applied using a flexible tube, syringe, pack, or another unique dispensing tool. A paste or gel dose form has the advantage that it is less likely to be thrown out of the animal's mouth than a tablet or liquid would be. Additionally, mass administration of animals with a paste medicine utilising a multi-dose applicator, such as a syringe, can be done swiftly and easily. A paste with the proper consistency will adhere to the tongue or oral cavity and be difficult to remove.

Eventually the animal will swallow it. A pet toothpaste that offers enduring protection for your pet's teeth and gums is called Biotene Maintenance Gel. Aqueous bases, greasy or oily bases, and organic solvents are the three different kinds of carriers that can be employed to create a paste or gel. The least expensive and least harmful carrier is aqueous base. The medication is dissolved in water or water and a co-solvent. The viscosity, cohesiveness, and flexibility of a substance can be increased by adding natural and synthetic gums, or polymers. A typical issue with aqueous bases is syneresis, or the separation of water in the gel. Absorbent materials like microcrystalline cellulose, kaolin, colloidal silica, starch, etc. can be utilized to solve this issue.

Animals are administered paste in volumetric dosages. The potency and density of the paste must be known in order to calculate the dosage that should be supplied per unit of volume.To determine the volume of paste needed to deliver the desired dosage, trial and error must be used during the formulation process. The pastes can occasionally be applied to a small animal's front legs to treat its fur. To keep itself clean, the animal licks the paste.

1.9 Drenches

Drenching refers to the process of giving medication to animals by forcing a liquid dose down their throats. Drinking guns or syringes are used to give drenches; the viscosity of the solution must be high enough to prevent leaking from the syringe as it travels from the medicine container to the can. Thickeners are also used to promote thixotropy of the product. The drinking gun can use less viscous formulations that provide a quick and easy means of oral administration of aqueous or oily solutions or suspensions.

Liquid drenching are of 3 types

1. Single dose injection gun for large volume distribution
2. Multi-dose drench pistol for delivering drench doses in staggered amounts.
3. Automatic flush guns are created to rapidly refill the chamber upon injection from a sizable volume reservoir, which is normally fastened to the operator's back.

1.10 Tubing products

A flexible tube is used to insert tubing items into the stomachs of the animals after passing through their nostrils. An aqueous solution or suspension is preferred for oral drugs since they are frequently supplied through tubing and can be flushed with water.

Example: A liquid medication is poured through a tube with a funnel affixed over the horse's head.

- For this procedure, a dosage of 10 fluid ounces is typical.
- To improve the flow rate, wetting agents are employed.

As the formulation thickens and opposes flow when shear is eliminated, thickening and suspending agents are contraindicated.

1.11 Topical Delivery System

There are solid (dusting powders), semi-solid (creams, ointments, and pastes) and liquid topical dose forms for treating animals (solutions, suspension concentrates, and emulsifiable concentrates). Particularly interesting are transdermal delivery systems, which transfer drugs over the epidermal barrier and into the bloodstream to have therapeutic effects. Examples include transdermal patches and gels applied to animals.

1.12 Transdermal Gel

A transdermal gel is a delivery system for medication into the bloodstream, most frequently pluronic lecithin organogel (PLO gel). The skin penetration of the medicinal substance in the formulation is improved by the micellar structure of the PLO gel. PLO gel is frequently well received and safe to eat.

Transdermal gels are used to deliver capsules to treat a range of conditions in pets, including unwanted behaviour, cardiac illness, and hyperthyroidism. A transdermal transport patch normally comprises of a reservoir filled with medication, a rate-restricting launch membrane, a protective backing layer, and an adhesive layer to connect the patch to the skin. The physical characteristics of a successful

medicine for transdermal delivery are preferably low molecular weight, high potency, water solubility (to promote drug release from the reservoir and to allow passage through the epidermal and dermal layers of the skin), and lipid solubility (to allow penetration of the stratum corneum of the pores and skin).

1.13 Transdermal Delivery Patch

Consists typically comprises an adhesive layer, a membrane to control the release of the medication, a backing layer to protect the skin, and a reservoir containing the medication. The best physicochemical properties for a medication are lipid solubility and molecular weight, which promote the drug's release from the reservoir and allow passage through the epidermal and dermal layers of the skin (to facilitate penetration into the skin). To make the skin's stratum corneum functional. Fentanyl, a synthetic opioid agonist, is given to dogs, cats, and horses via a transdermal patch.

- There are several unique topical dosage forms for animals.
- Dust bags, (b) dips, and (c) flea and tick collars
- **Dust Bags:** Using a tool called anthers, cattle are treated with insecticidal powders. Animals are dosed by rubbing them on the bags that they are walking alongside or below. The powdered pesticide formulation is kept in a porous inner storage bag that is part of the pouch. An outer, waterproof protective skirt that is exposed at the bottom to the porous dust bag shields this from the weather. Cattle may have the option to use anthers freely or may be compelled to do so, depending on where they are hanging. Bags for mandatory use are hung on doors, sidewalks, entrances, etc. The bags can be used in a variety of ways by being hung from elevated objects like a tree or a pole. The majority of grazers' willingness to cooperate is surprising to apply for a job of their own choosing.
- **Dips:** The main formulations for dipping chemicals include aqueous solutions, emulsifiable concentrates, and suspension concentrates, all of which need to be diluted with water before use. The cost of labour, the cost of the chemicals used to fill the large tanks, and the disposal of hazardous waste account for the majority of the high costs associated with immersion. A dip formulation containing the drug is diluted in a large dip bath through which the animal is carried. This swimming area needs to be big enough to fit Animal—long, wide, and deep. Ectoparasiticide synthesis is difficult. It must be stable over a range of concentrations and temperatures and not be rendered inactive by chemicals collecting in the immersion bath. Additionally, it is acceptable to be non-toxic to animals yet poisonous to ectoparasites.
- **Fleas and Tick Collars:** Due to the fact that this dosage form is used for pets (dogs and cats) and is sold in the majority of pharmacies, grocery stores, and veterinary offices, the pharmacist will be more familiar with it. The two types of flea and tick collars are powder and vapour collars, often known as slow-release pesticide generators.. Both comprise a plasticized solid thermoplastic resin and an insecticide. The liquid insecticide that is mixed throughout the vapour collar has a reasonably high vapour pressure. The poison slowly dissipates, killing the pest by filling the area around the animal's surface with a poison mist. However, the animal is unaffected by it. Fleas and ticks frequently focus on or pass through the animal's neck region. They subsequently perish after coming into contact with the active pesticide on or discharged from the collar..Dust-producing collars have an advantage over steaming collars in that they increase the contact area and let you continue getting rid of ticks and fleas while the dog or cat is moving, rubbing or wiping the dust crystals (bloom) onto the coat.

1.14 Veterinary Vaccines

Farmers incur considerable costs as a result of the morbidity and death caused by infectious diseases, which can be prevented or decreased by vaccination. Nevertheless, depending on the length of protection required, immunizations should be administered at least twice and booster doses should be given every 12 to 24 months, but typically every 3 months. The issue of non-compliance with the vaccination protocols advised by farmers is brought on by the high costs associated with the management of the animals (pastures, etc.). Therefore, vaccination of livestock with a single dose vaccine employing controlled release technology would be highly advantageous. The purpose of controlled-release veterinary vaccines, in contrast to other preventative or therapeutic medications that can only target a single

biological target, is to provide to the immune system a package of an immunogenic and an immunostimulant.Molecules in a specific way that results in relevant and sustained immunity. To do this, the immune system must be carefully introduced to the antigen together with the proper immunological signals. Formulation scientists have made numerous attempts to do this with a pulse delivery mechanism.

2. CONCLUSION

Veterinary drugs are essential for maintaining and regaining animal health and improving human wellbeing. Maintaining animal health and productivity in companion animals requires efficient development of novel, effective animal medicines as well as accountability for products that have been licensed. Animals numerous illnesses that affect humans and animals alike are treated using medications for animals. Based on the distinct features of mammalian and avian physiology, animal dosage forms have their own requirements and peculiarities. Numerous medications are either not used in human medicine or are only used in veterinary care. Your food might not be aware of its qualities. The pharmaceutical, therapeutic, pharmacological, chemical, biochemical, pharmacological dose forms, and pharmacokinetic features must be understood by the pharmacist before they can work in this field.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Rakesh Babu S. N	✓	✓	✓	✓		✓		✓	✓	✓	✓			✓
Gururaj S Kulkarni	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Yuktha HJ	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

The study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki and approved by the relevant institutional authorities.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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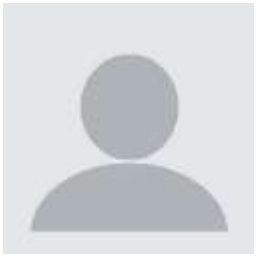
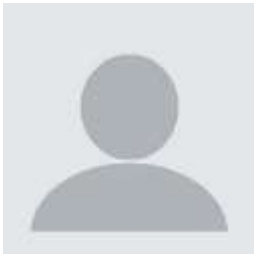
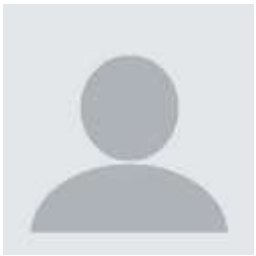
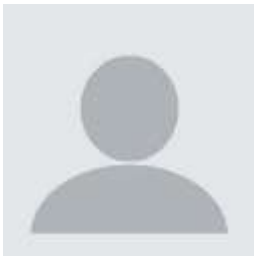
	**Rakesh Babu S. N,** is a student in the Department of Pharmaceutics at the Oxford College of Pharmacy, Bangalore, Karnataka, India. He is actively involved in pharmaceutical research and academic activities with a keen interest in drug formulation, novel drug delivery systems, and pharmaceutical technology. He is dedicated to advancing his knowledge in the field of pharmaceutics and contributing to innovative healthcare solutions through research and scientific learning.
	**Gururaj S Kulkarni,** Professor and HOD, Department of Pharmaceutics, The Oxford College of Pharmacy Banglore Karnataka, India. He is actively being engaged in research in Computer Science, and his interests cover artificial intelligence, machine learning, data analytics and also new computational technologies. In addition, he's focused on pushing forward fresh research approaches and usable tech solutions through academic cooperation, plus cross field research activities. Email: oxfordceutics@gmail.com
	**Yuktha HJ,** is a student in the Department of Pharmaceutics at the Oxford College of Pharmacy, Bangalore, Karnataka, India. She is passionate about pharmaceutical sciences and actively engaged in academic and research activities related to drug development and healthcare innovations. Her areas of interest include pharmaceutics, formulation research, and modern drug delivery systems. She is committed to enhancing her scientific knowledge and contributing to the advancement of pharmaceutical research and patient care.

	**Padma M Paarakh,** is the Principal and a distinguished academician in the Department of Pharmacognosy at the Oxford College of Pharmacy, Bangalore, Karnataka, India. With extensive experience in teaching, research, and academic administration, she has contributed significantly to the field of pharmaceutical sciences. Her research interests include pharmacognosy, herbal medicine, and natural product research. She is dedicated to promoting quality education, scientific innovation, and research excellence in the field of pharmacy.