



O.184

Accuracy of dosing pumps: influence of type and maintenance

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Introduction

Good practices when using medicines in farms are essential to get drug efficiency, to respect the maximum residue limits in meat and to prevent the development of antimicrobial resistance. In particular, water medication administered with a dosing pump requires a well-dissolved and homogeneous solution at drinkers (1), a good regulation of the flow at drinkers and a reliable equipment. The aim of this study was to evaluate the dosing accuracy at farm levels, according to type of pumps and maintenance.

Materials and Methods

Three equipments were compared:

- A hydraulic pump (HP1) used in a farm during 4 years without any maintenance.
- HP1 after maintenance procedure (HP2).
- An electric pump after maintenance procedure (EP).

Pumps were set up on an experimental pipe and tested with 9 combinations of 3 pressures (3, 1.5, 0.5 bars) and 3 water flows, matching farm values: 600 l/h simulated high fattening flows (10 drinkers set at 1 l/min and used simultaneously). 30 and 300 l/h simulated low and intermediate post-weaning flows (1 and 10 drinkers in use and set at 0.5 l/min).

The dosing rate of the pumps was set at 5%, as it is the most frequently used on French pig farms (2). EP was also set at 10% to check how it affected the accuracy.

During each test, after filling up the tank with water, the weights of the stock solution (W1) and of the water collected downstream (W2) were recorded every 10 kg (20 measures). For an expected dosing rate of 5%, the observed one was calculated as: $((\text{initial } W1 - \text{final } W1) \times 105) / W2$.

We compared average observed dosing rates, coefficients of variation (CV) and the percentage of the dosing rates, irrespective of the 5% margin error set by the manufacturer.

Results and discussion

At 300 and 600 l/h, HP1 had average dosing rates between 4.96 and 5.10% with CV below 3% (Table 1), which is quite correct. On the opposite, at 30 l/h, results lied between 1.52 and 3.75% and CV reached 69% at 3 bars. A hydraulic pump that has worked regularly without any maintenance will underdose at low flows, sometimes injecting less than one third of the expected volume.

HP2 was tested only at problem flow (30 l/h). Average dosing rates were between 5.17 and 5.27% with all CV below 3%. So, maintenance clearly improved dosage accuracy.

EP, set at 5%, had correct results at 30 and 300 l/h (CV < 5%) with minor overdosing (between 2 and 5%). But at 600 l/h, EP underdosed and injected only 60% of expected volume. When the pump was set at 10%, the trends were the same. So, with post-weaning flows, electric pump was less accurate than hydraulic pump, though still acceptable. However, EP was not suitable with high fattening flows.

Conclusion

The regular maintenance of the pumps is crucial to get correct dosage accuracy. It consists in rinsing out the system after each use and performing yearly maintenance work on the pump.

Moreover, hydraulic pump is suitable with post-weaning and fattening flows. But, electric pump is accurate only with post-weaning flows. It would be of interest to reset the rhythm of the electric pulse in order to be more compatible with higher fattening flows and to avoid underdosing.

References

1. Hémonic A., et al. (2010). J. Rech. Porcine, 42, 253.
2. Corrége I., et al. (2008). Techniporc, 31, 17-21.

Table1: Accuracy of dosing pumps

	flow (l/h)	30 l/h	30 l/h	30 l/h	300 l/h	300 l/h	300 l/h	600 l/h	600 l/h	600 l/h
pump	pressure (bars)	3	1.5	0.5	3	1.5	0.5	3	1.5	0.5
HP1	Avg. dosing rate / CV (%)	1.52/69	3.23/5	3.75/14	4.96/1	5.02/2	5.10/2	5.0/1	5.04/1	5.09/2
HP1	% dos. rate >5.25% / <4.75%	0/100	0/100	5/95	0/0	0/0	0/0	0/0	0/0	10/0
HP2	Avg. dosing rate / CV (%)	5.17/2	5.25/2	5.27/1	not tested					
HP2	% dos. rate >5.25% / <4.75%	5/0	42/0	55/0	not tested					
EP 5%	Avg. dosing rate / CV (%)	5.10/2	5.35/4	5.39/3	5.14/1	5.37/1	5.50/2	2.87/23	2.84/13	2.86/4
EP 5%	% dos. rate >5.25% / <4.75%	20/0	60/0	55/0	0/0	85/0	100/0	0/95	0/100	0/100
EP 10%	Avg. dosing rate / CV (%)	not tested	not tested	not tested	10.42/3	10.8/1	11.43/1	7.52/25	6.23/24	6.14/2
EP 10%	% dos. rate >10.5% / <9.5%	not tested	not tested	not tested	55/0	100/0	100/0	10/80	5/95	0/100