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► **To cite this version:**

Tarek Bouzouraa, Benoit Rannou, Julien Cappelle, Jeanne-Marie Bonnet-Garin, Jean-Luc Cadoré. Formula for the estimation of urine osmolality in healthy cats. *Research in Veterinary Science*, 2021, 135, pp.121-126. 10.1016/j.rvsc.2021.01.009 . hal-03137022

HAL Id: hal-03137022

<https://hal.inrae.fr/hal-03137022>

Submitted on 13 Feb 2023

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1 Formula for the estimation of urine osmolality in healthy cats

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25 **Abstract**

26 A simple and intuitive formula for the estimation of urine osmolality (U_{osm}) using the
27 measured concentrations of major active urine osmolytes over a wide range of urine dilutions was
28 proposed in healthy cats. Sixty-three urine samples were retrieved using ultrasound-guided
29 cystocentesis from sixteen healthy cats under 5 years of age receiving intravenous infusion over a
30 period of 24 hours. Samples were collected at baseline (T_0), T_2 , T_6 , T_{12} , and T_{24} . Urine osmolality
31 was measured using a freezing-point osmometer, and the concentrations of osmolytes (urea,
32 sodium, glucose, and potassium) were evaluated. A simple linear regression model for a clinical
33 use was selected, and the agreement between the calculated and actual urine osmolalities was
34 assessed. Urinary concentrations of urea, sodium and glucose were the three variables included in
35 the model with the lowest AIC_c. Urine osmolality can be predicted accurately and precisely using
36 urine urea, sodium and glucose with the following equation: $U_{osm} = 1.25 \times \text{urea (mmol/l)}$ or 20.87
37 $\times \text{urea (g/l)} + 1.1 \times \text{sodium (mmol/l)} + 67 \times \text{glucose (mmol/l)}$ or $3.72 \times \text{glucose (mg/dl)}$. The
38 concordance correlation coefficient for repeated measures between the actual and the calculated
39 urine osmolality was extremely close to 1, which supported a high agreement : 0.996 (CI 95% :
40 [0.993 ; 0.998]). In a population of healthy cats, urine osmolality can be predicted accurately and
41 precisely using urinary urea, sodium and glucose concentrations. Similar formulae could
42 potentially be established to help the clinician in pathological situations.

43

44 **Key words**

45 Feline, urine osmolality.

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49 **Introduction**

50 Urinalysis is a routine in-clinic procedure that provides relevant information about the
51 kidney function and systemic health in small animal practice. Urine osmolality (U_{osm}) depends on
52 the amount of osmotically active molecules in the urine including nitrogenous waste compounds
53 (urea, creatinine), uncharged molecules (glucose), and major ions (sodium and potassium
54 mainly)¹⁻³. In contrast to urine specific gravity (USG), U_{osm} is independent of the molecular
55 weight of urine osmolytes (Cottam et al., 2002; Imran et al., 2010; Voinescu et al., 2002). In
56 humans, U_{osm} might be more accurate than USG for the prediction of hydration status and renal
57 tubular function in normal physiological situations but also in some pathologic states (Imran et
58 al., 2010; Voinescu et al., 2002). A retrospective study in healthy cats reported that U_{osm} and
59 USG correlated roughly over a narrow range of hypersthenuric urine samples (Di Bella et al.,
60 2014). As U_{osm} evaluation requires a sophisticated device (freezing-point osmometer) and a
61 skilled operator, its use in daily clinical practice remains considerably limited. In humans and
62 cats, some studies propose additive formulas for the estimation of plasma osmolality in
63 physiological and pathological states using the concentrations of the major components (Dugger
64 et al., 2013; Khajuria and Krahn, 2005; Schermerhorn and Barr, 2006). To the authors'
65 knowledge, no similar publications have proposed a comparable estimation of U_{osm} in feline
66 species. We aimed at establishing a formula that estimate U_{osm} using the concentrations of
67 osmotically active molecules in urine samples from healthy cats.

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73 **Material and methods**

74

75 Inclusion criteria

76 Only healthy vaccinated and dewormed cats younger than 5-years-old and belonging to
77 students of our Veterinary Teaching Hospital were enrolled. The included cats had normal
78 physical findings and their history did not indicate any previous disease. They were receiving
79 regular internal and external parasite control products. The included cats were never given any
80 other medication. For every included cat, the protocol began at 8:00 am (corresponding to T₀).
81 Baseline blood urea nitrogen, serum creatinine, urine dipstick analysis, urine specific gravity
82 assessment and sediment examination were performed to rule out chronic nephropathy,
83 pathologic glucosuria, proteinuria, pigmenturia, pyuria, bacteriuria and urinary tract
84 inflammation. Systemic hypertension was ruled out by an ECVIM-CA resident [REDACTED] based on
85 Doppler sphygmomanometry technique recommended by ACVIM consensus statement (Brown
86 et al., 2007) using manual ultrasonic Doppler flow detector model (811-B, Parks Medical
87 Electronics®; Aloha, USA).

88

89 Procedures

90 A 23 Gauge intravenous (IV) catheter was placed on the right thoracic limb (cephalic
91 vein). The cats received IV infusions of isotonic Lactated Ringer's solution (RL) at a flow rate of
92 4 mL/kg/h over 24 hours. Urine samples were collected by ultrasound-guided cystocentesis at
93 baseline (T₀) and at several time-points subsequently (at 2 hours: T₂, only if the urinary bladder
94 filled before cystocentesis, 6 hours: T₆, 12 hours: T₁₂ and at 24 hours: T₂₄). Clinical and
95 cardiopulmonary variables were assessed hourly during the 24-hour period by an undergraduate
96 student using a dedicated examination sheet, an ECVIM-CA resident ([REDACTED]) and his supervisor

97 (■■■■), ECVIM-CA Diplomate. The cats were provided regular dry feline diet and free water
98 access during the procedure. For ethical reasons, the cats were directly excluded from the
99 protocol if they showed any abnormal clinical finding or if they were reluctant to physical
100 restraint for the cystocentesis. A follow-up examination was systematically performed at 3, 6 and
101 12 months. During the visits, we recorded all information reported by the owners and we
102 performed a complete physical examination (including cardiopulmonary auscultation and
103 temperature assessment). The protocol was reviewed and approved by our institutional ethical
104 committee ■■■■■ and informed consents were obtained from owners.

105

106 Measurements

107 Urine samples were kept refrigerated in closed hermetic silicone tubes (Vacutainer®,
108 Coveto, La Guyonnière, France). The samples were processed within a delay of 1 to 12 hours to
109 avoid significant evaporation and measurement artifacts. Urine samples were initially assayed for
110 urea, sodium, glucose, potassium, creatinine, bicarbonates, chloride and lactates. Preliminary
111 statistical analyses were performed using urea, sodium, glucose, potassium and creatinine. Then,
112 considering the current knowledge relative to the calculation of plasma osmolality in humans
113 (Khajuria and Krahn, 2005) and small animals (Dugger et al., 2013; Schermerhorn and Barr,
114 2006), along with the findings extracted from an earlier report (Voinescu et al., 2002) relative to
115 the impact of urine osmolytes on osmolality, then to ensure the best clinical applicability on the
116 field, only urea, sodium, glucose, and potassium measurements were selected in the baseline
117 model. These variables were also selected considering their expected concentrations in feline
118 urines (Cottam et al., 2002). The samples were submitted for biochemical measurements of urea,
119 sodium and glucose using a dedicated analyser (Konelab 30i, Thermo Scientific®; Cergy
120 Pontoise, France). Potassium was assessed using the molybdate method, as reported by Zilva and

121 Nicholson (1973). Prior to osmolality assessment, the samples were acclimatized to ambient
122 room temperature for 30 minutes. U_{osm} was measured using a freezing-point osmometer by 2
123 qualified technicians (Digital Micro-Osmometer, Roebbling[®]; Giessen, Germany). For each
124 individual urine sample, both operators evaluated U_{osm} once. The 2 technicians were blinded to
125 the measurement of each other.

126

127 Statistical analysis

128 Statistical analysis was performed using statistical software (R[®] Development Core Team
129 (2008). R: A language and environment for statistical computing. R Foundation for Statistical
130 Computing, Vienna, Austria. ISBN 3-900051-07-0, URL <http://www.R-project.org>). For
131 baseline descriptive data (U_{osm} and urine osmolyte concentrations), numerical values were
132 reported, as mean, median, minimum and maximum. Relationships between urinary osmolytes
133 concentrations (urea, sodium, glucose, and potassium) and actual U_{osm} were studied using a
134 series of generalized linear mixed models (GLMM) with the variable ‘Cat identification’ used as
135 an explanatory variable with a random effect in order to take into account the non-independence
136 between measures made on a same cat. Furthermore, in order to take into account the non-
137 independence between measures made on a same cat at the same time, we used an autocorrelation
138 structure with a categorical time covariate, the variable “Time”. Each of all possible
139 combinations of one to four of the four different osmolytes selected in the study were tested as
140 explanatory variables, with the actual osmolality as the response variable, using the `glmulti`
141 package (Calcagno and de Mainzancourt, 2010). For model comparison, we considered the small
142 number of samples. Therefore, we used the Akaike Information Criteria corrected for small
143 sample sizes (AIC_C). We selected the model with the lowest AIC_C as the final model, and the
144 differences of the AIC_C between models was interpreted according to Burnham (2002). For better

145 clinical applicability, we simplified the formula to obtain an easy-to-use additive formula without
146 ordinate (we forced intercept to 0). For the same reason, the variable 'Time' was not included as
147 an explanatory variable in this simplified model, as it would be impractical to use it for daily
148 clinical activities. We additionally ran a similar model with an intercept and with 'Time' as a
149 categorical factor (supplementary data).

150 Afterward, the agreement between the calculated and actual U_{osm} was assessed thanks to
151 the concordance correlation coefficient (CCC) for repeated measures in the cccrm:ccclon package
152 (Carasco et al., 2009; Carasco et al., 2013). This method relies on a linear mixed modeling
153 approach, the assumptions of the linear model (linearity, homoscedasticity and normality of the
154 residuals) were thus verified graphically prior to the analysis. To account for the lack of
155 independance of the observations and due to the design of the study, an autoregressive correlation
156 structure was chosen for the mixed model. The results of the CCC were interpreted using the
157 scale proposed by McBride (2005). The limits of agreement represented by the bias and their
158 95% confidence intervals were estimated using the Bland Altman method (Bland and Altman,
159 2007). The plot was generated to reinforce the interpretation of the data.

160

161

162 **Results**

163 Population included

164 Twenty-one cats were initially enrolled. However, 5 cats were excluded. The
165 cystocentesis was not possible for 3 cats and 2 other cats had dyspnea after 0 and 2 hours of
166 intravenous infusion, respectively. Sixteen domestic short haired cats completed the protocol
167 without any complication. All five urine samples were available for 6/16 cats, while 1/5, 2/5 and
168 3/5 samples were unavailable for 5/16, 3/16 and 2/16 cats, respectively. Sixty-three samples were

169 finally processed. No complication was reported during the procedure. Fifteen out of the 16
170 included cats had normal 3, 6 and 12-months rechecks. The 16th died from a hit-by-car accident at
171 2 month.

172

173 Urine osmolality and osmolytes evaluation

174 The paired measurements of urine osmolality with the freezing-point osmometer were
175 completely identical between the 2 operators. Urine osmolality varied over a wide range. Mean,
176 median, minimum and maximum values for urinary urea, sodium, glucose, and potassium are
177 indicated within Table 1. The relationship between the actual and the calculated U_{osm} can be
178 appreciated on Figure 1.

179

180 Derived formula

181 Of all possible subsets and combinations of urea, sodium, glucose, and potassium the AIC
182 indicated that the model with urea, sodium, and glucose preferable (Table 2 and supplementary
183 data 1 and 2). The GLMM including urea, sodium and glucose (all in mmol/l) and no intercept
184 resulted in the ensuing formula: $U_{osm} = 1.25252 \times \text{urea} + 1.05320 \times \text{sodium} + 66.72193 \times \text{glucose}$
185 ($AIC_C = 843.551$). The difference between the AIC_C indices of the first and the second model was
186 greater than 2. This supports our choice of the first model (Burnham, 2002).

187 The following simplified model would be acceptable for better practical use: $U_{osm} = 1.25$
188 $\times \text{urea (mmol/l)}$ or $20.87 \times \text{urea (g/l)} + 1.1 \times \text{sodium (mmol/l)} + 67 \times \text{glucose (mmol/l)}$ or $3.72 \times$
189 glucose (mg/dl) . The concordance correlation coefficient for repeated measures was 0.996 (CI
190 95% : [0.993 ; 0.998]), which can be considered, as ‘almost perfect’ according to McBride
191 (2005). The visual inspection of the limits of agreement plots suggested the closeness of
192 agreement between the 2 variables (Figure 2). The fixed bias, defined as the means of the

193 differences between the calculated and actual U_{osm} was -7.30 mosm/kg, meaning that, on average,
194 the calculated U_{osm} was 7.30 units lower than the actual value. The range of the differences
195 (defined by calculated minus actual osmolality) was $-480,85 : +612,25$ mosm/kg. Bland-Altman
196 95% limits of agreement between the actual and calculated U_{osm} were $-370.32 : +334.21$
197 mosm/kg. The differences were not homogeneous across the range of means of the calculated and
198 actual U_{osm} but were more negative at low means and more positive at high means.

199

200 **Discussion**

201 Urine osmolality can be predicted accurately and precisely using urine urea, sodium and
202 glucose in healthy cats with the following equation: $U_{osm} = 1.25 \times \text{urea} + 1.1 \times \text{sodium} + 67 \times$
203 glucose (mmol/l) or $3.72 \times \text{glucose (mg/dl)}$.

204 One important finding is that the mean osmolyte gap (or fixed bias) estimated with the
205 preceding formula was very small (-7.30 mosm/kg) when compared to the huge variation of urine
206 osmolality of the cats included (ie. 302 to 2940 mosm/kg). This small gap strongly suggests that
207 the formula is accurate and reinforces its applicability in clinical practice. Moreover, the Bland-
208 Altman 95% limits of agreement between calculated and actual U_{osm} were $-370.32 : +334.21$
209 mosm/kg. This finding means that one would expect 95% of samples to have estimates of urine
210 osmolality between 370.32 mosm/kg less than and 334.21 mosm/kg greater than the actual value.
211 Considering the large physiological variation in feline urine osmolality (Table 1 and Figure 1),
212 this is an acceptable difference (around 5%) for healthy cats in physiological condition and
213 highly concentrated urines. However, this gap is not negligible for the cats with diluted urines
214 (i.e. those receiving IV infusion during hospitalisation). Moreover, the method used treated each
215 sample as if it was independent of each other sample. In this setting, one must know the
216 generated 95% confidence intervals in the Bland Altman method results are probably unduly

217 narrow. Interestingly, the differences observed between the 2 methods were not homogeneous
218 across the range of means of the calculated and actual osmolalities. Indeed, calculated values
219 tended to be lower than actual at high means and higher than actual at high means. This
220 proportional bias might probably occur subsequently to the fact that we selected a model without
221 intercept. Actually, the presence of an intercept for this type of formula would have improved fit.
222 Indeed, considering the low concentration of glucose within urines with comparison to urea and
223 sodium, the implication of this osmolyte is more important in diluted urines (with a low
224 osmolality) than in highly concentrated urines (higher osmolality). This effect could have been
225 reduced and even corrected if we had allowed an intercept in the GLMM (rather than forcing the
226 intercept to be 0). However, we had the objective to develop a formula that would be the easiest to
227 use for the practitioner in daily clinical practice. In this setting, we considered the model
228 proposed by Dugger et al (2013) for the estimation of plasma osmolality in cats. This model
229 consisted in a formula that involved only urea, sodium and glucose and that had no intercept. Its
230 clinical applicability and relevance justified the choice that led to the final formula in the present
231 study.

232 Currently, the use of U_{osm} in small animals remains limited and its role needs to be
233 evaluated. Some studies reported the physiologic variations of U_{osm} in dogs and cats, while
234 several reports documented some degree of correlation or agreement with USG (Ayoub et al.,
235 2013; Di Bella et al., 2014; Imran et al., 2010; Van Vonderen et al., 1997; Wardrop, 2008). These
236 studies suggested that USG could be an acceptable marker of renal tubular function in daily
237 clinical practice but is still imperfect. Unfortunately, the relationship between USG and U_{osm} has
238 mostly been evaluated and validated in canine species (Ayoub et al., 2013). Indeed, the few series
239 available in cats are subjected to some major analytical pitfalls (Di Bella et al., 2014; Ross and
240 Finco, 1981). An earlier study evaluated some pathologic urine samples retrieved from azotemic

241 cats following renal mass reduction via vascular ligation or nephrectomy (Ross and Finco, 1981).
242 A more recent study evaluated the relationship between USG and U_{osm} in healthy cats, for which
243 almost all urine samples were highly concentrated (Di Bella et al., 2014). As a general principle,
244 predicting with high precision is more difficult when the outcome variable has a narrow range. In
245 that study, the narrow range of urine density might actually have affected the accuracy of the
246 predicted linear correlation. Moreover, the operators used a refractometer, which was not
247 designed to estimate USG over the value of 1.050, and no urine dilution was performed for
248 severely hypersthenuric samples. Thus, for a subset of highly concentrated urine samples, USG
249 could not be actually estimated. Instead, a random approximate of USG value was assigned to
250 meet the prerequisites of the statistical analysis. In this background, the relationship between
251 USG and U_{osm} could hardly be evaluated with these results. It is thus valuable to evaluate the
252 agreement between USG and U_{osm} and build the formula through the use of wider range of urine
253 dilution in healthy cats, as it has recently been proposed in dogs¹¹. In our study, the proposed
254 formula was derived using a wider range of urine osmolality (from 302 to 2940 mosm/kg).

255 We aimed at developing the easiest additive model and the final formula fulfilled our
256 requirements. The final model only consisted of 3 osmolytes, which were found to collectively
257 result in the model that was most likely to predict future values accurately (Table 2). The
258 proposed models did not consider the impact of pathologic osmolytes accumulation (e.g., ketone
259 bodies or toxins). The reliability of the final formula is thus only proven in normal physiological
260 conditions. Similar formulas could thus be tested at some point for clinical evaluation of
261 pathologic cases. Indeed, it would be interesting in the future to ascertain the reliability of
262 supplementary models on urine samples retrieved from sick cats suffering from different
263 urological conditions (chronic kidney disease or acute kidney injury), metabolic (diabetes
264 mellitus or primary hyperaldosteronism) or inflammatory/infectious diseases.

265 Our study includes several limitations. Urine ammonia, calcium and phosphate
266 concentration were not selected during the statistical analysis, though some studies report that
267 their concentrations are not negligible (Cottam et al., 2002; Di Bella et al., 2014; Imran et al.,
268 2010; Voinescu et al., 2002; Wardrop, 2008). We did not perform urine bacterial culture to rule
269 out subclinical bacteriuria. However, this condition occurs rarely in younger healthy cats showing
270 no clinical or cytological finding consistent with urinary tract inflammation (Lister et al., 2011).
271 Moreover, it would have been better to rule out any subclinical chronic nephropathy (IRIS stage I
272 CKD) to completely ascertain the healthy status of the cats. This would have required an
273 ultrasonographic examination and the measurement of symmetrical dimethylarginine (SDMA).

274 The basic concepts of objective standardization in clinical laboratory require specific
275 anticipation and preparation that are documented in a dedicated review (Jensen et al., 2006). The
276 present protocol does not appear to be completely standardized according to these
277 recommendations. However, the design of our study still meets the conditions proposed in the
278 preceding review. Among these 9 points, the investigators need to estimate the random error for
279 both methods. The estimation should be done before the analysis. Our statistical model suggests
280 that the formula underestimates urine osmolality by a mean of 7.30 mosm/kg. Unfortunately, this
281 fixed bias was obtained only after the completion of the study. Thus it could only be applied in
282 future research. Additionally, according to the aforementioned review, the investigators needed to
283 predict an acceptable difference for the measurement of U_{osm} with the osmometer (i.e. the
284 analytical error). We initially projected this analytical error around less than 10% of the
285 physiologic feline U_{osm} (i.e. 200–300 mosm/kg). This means that if the paired measurements for
286 every given sample would have differed by less than 200 to 300 mosm/kg between the 2
287 operators, then the final model could be considered acceptable. Our projection was finally far
288 much greater than the actual analytical error. Indeed, the paired measurements of urine osmolality

289 were completely identical between the 2 operators. For these reasons, this final point is no longer
290 an issue. Moreover, using some specific tools, the projected number of samples to be included
291 could roughly be predicted around 30 to 50. For this reason, we included the largest number of
292 samples possible during the study period, and this number (63 samples) is above the minimal
293 recommended threshold (40 samples).

294 In this setting, our methodology to built the equation appears suitable to constitute a
295 theoretic basis and a preliminary pilot study that would help for future research.

296 Cystocentesis was preferred over manual urinary bladder compression for urine sampling
297 because the latter can cause traumatic rupture and ureteral reflux, especially in male cats
298 (Osborne et al., 1996). Furthermore, repeated urinary catheterization can predispose to iatrogenic
299 urinary tract infections (Lees et al., 2006). None of the cats developed complications after
300 sampling and every cat that was reluctant to the procedure at first attempt was excluded.

301

302

303 **Conclusion**

304 The proposed formula is easy to use and can help for a rapid estimation of urine
305 osmolality in healthy cats. At this step, our findings are only relevant to healthy cats and the
306 proposed model needs to be re-evaluated and validated on a larger population using a prospective
307 design. It would be interesting in the future to find similar equations suitable for pathological
308 conditions, especially in diabetic or glucosuric patients.

309

310 **List of abbreviation**

311 ACVIM: American College of Veterinary Internal Medicine

312 AICc: Akaike Information Criteria for small samples

313 CKD: Chronic Kidney Disease
314 ECVIM: European College of Veterinary Internal Medicine
315 IRIS: International Renal Interest Society
316 IV: Intravenous
317 RL: Ringer Lactate
318 U_{osm} : Urine osmolality
319 USG: Urine Specific Gravity

320

321 **Ethical approval**

322 Ethical committee (cometh 2015_1527, VAS, n°18) – Data provided

323

324 **Consent for publication**

325 All authors gave approval and consent for publication.

326

327 **Availability of data and material**

328 The data generated or analysed are included as supplementary material or within
329 additional files that are available.

330

331 **Competing interest**

332 The authors declare that there is no conflict of interest regarding the publication of this
333 article.

334

335 **Funding**

336 This research did not receive any specific grant from any funding agency.

337

338 **Authors contribution**

339 TB, JMB, and JLC substantially contributed to the conception of the protocol while BR,
340 JC, JMB, and JLC contributed to the design of the study. TB and JLC were involved in the
341 acquisition of data, JLC, BR and JMB in the interpretation of data and JC in the analysis of data.
342 TB and JLC drafted the manuscript while BR, JMB, JC and JLC critically revised and prepared
343 the manuscript. All authors gave final approval and approved the final manuscript.

344

345 **Acknowledgements**

346 The authors want to acknowledge DVM [REDACTED] for assistance in the
347 collection of data.

348

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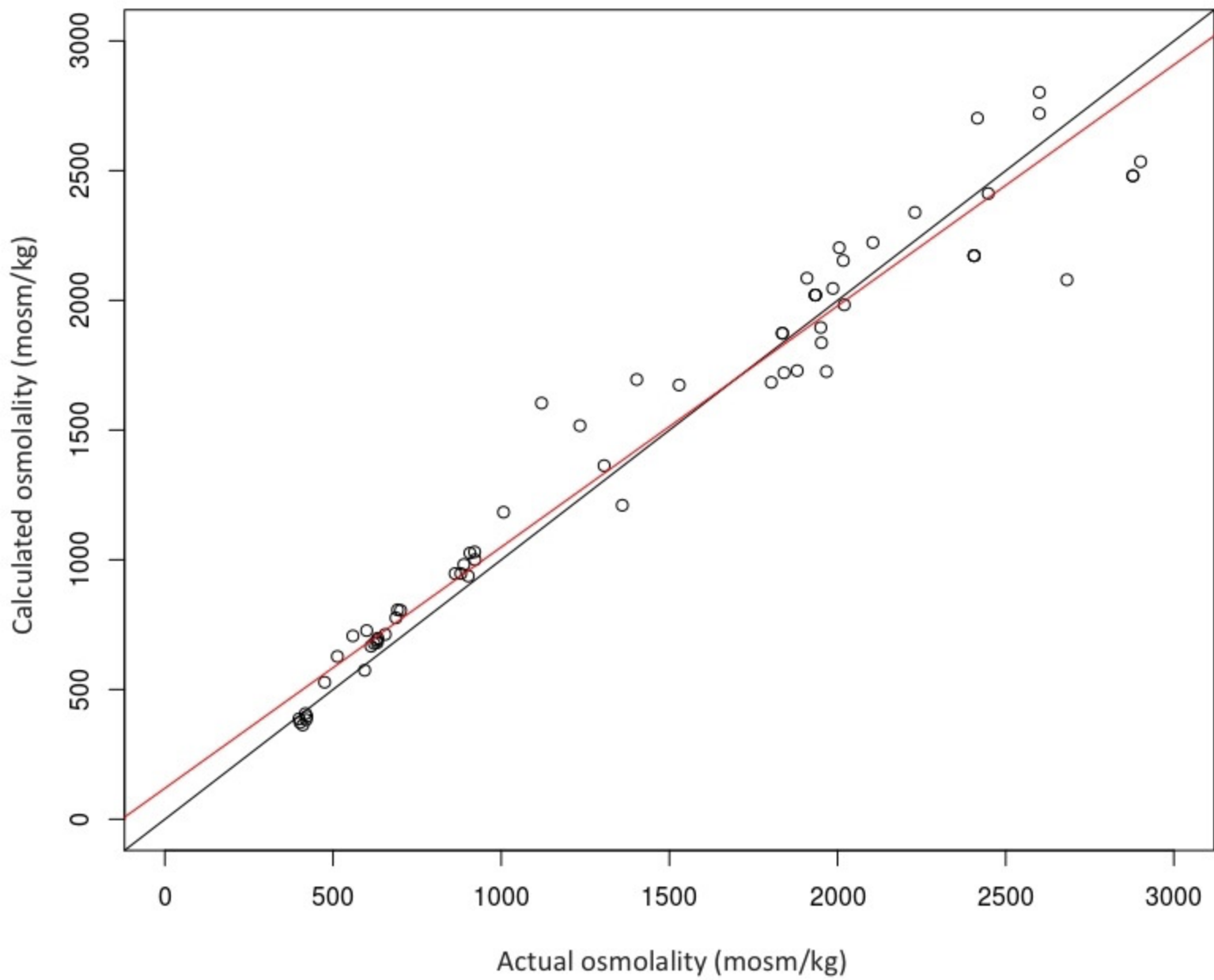
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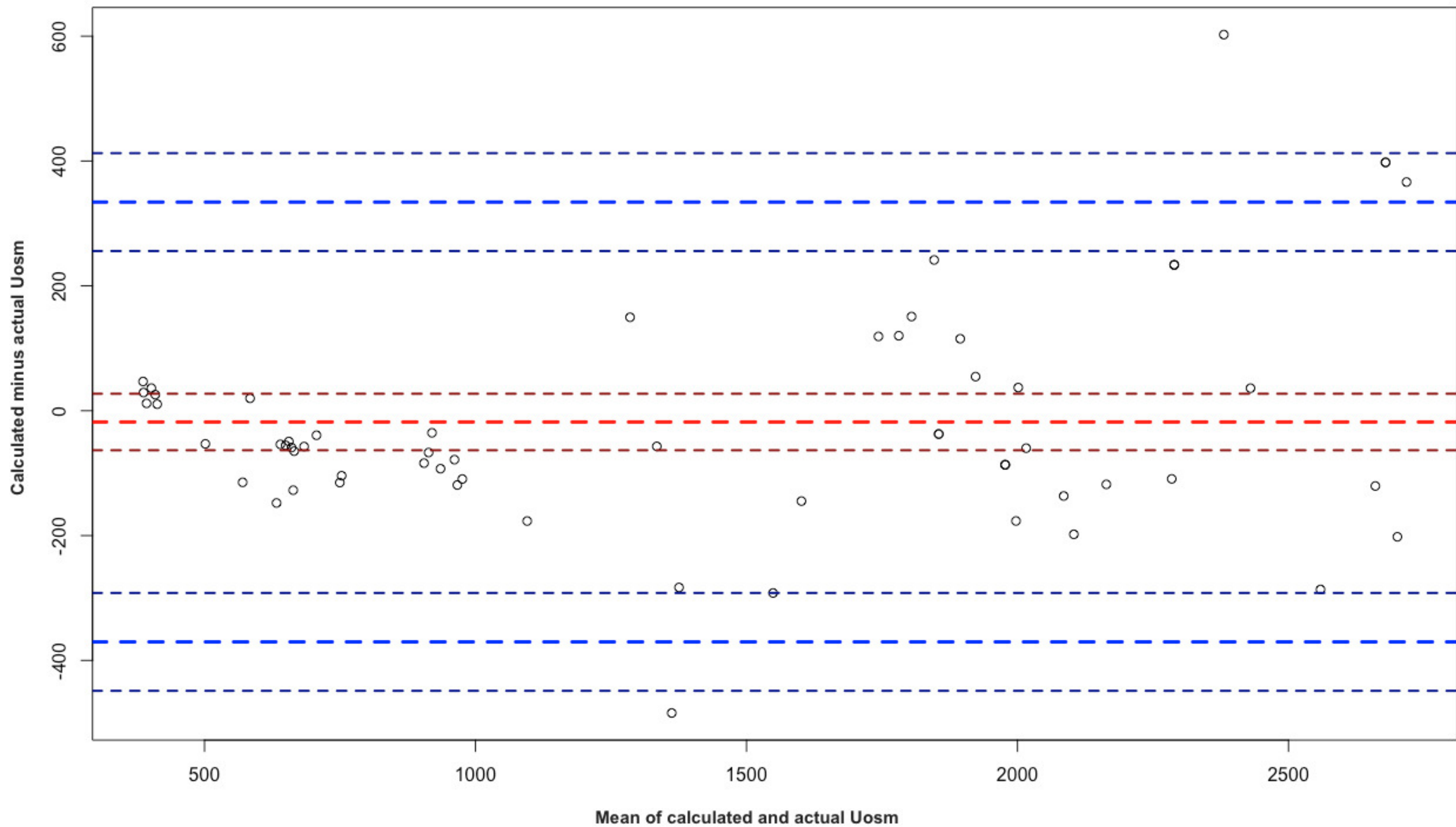
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1 Figure 1. Agreement between calculated and actual urine osmolalities in healthy feline
2 patients. The line of best fit (red) is the line that best crosses the scatter plot to express the
3 relationship between the 2 variables. This line was obtained by applying the reduced major
4 axis method. The black line represents the line of perfect concordance (ie the line of perfect
5 agreement between the 2 variables).

6 Figure 2. Bland-Altman plot for all samples illustrating the difference between calculated and
7 actual urine osmolalities. The thick red dashed reference line represents the osmolyte gap
8 value, defined as the mean of the differences between calculated and actual urine osmolalities
9 (-7.30 mosm/kg). The thinner red dotted lines correspond to its lower and upper 95%
10 confidence intervals (- 63.32 ; + 27.21 mosm/kg). The thick blue dashed lines represent the
11 lower and upper bounds of 95% limits of agreement for the difference between calculated and
12 actual osmolality (- 370.32 : + 334.21 mosm/kg). The thinner blue dotted lines correspond to
13 the lower and upper limits of their 95% confidence intervals..





Variables	Units	Mean	Median	Minimum	Maximum
Urea	(mmol/L)	808.6	931.4	71.9	1736
Sodium	(mmol/L)	149.8	146.0	87.0	202.0
Glucose	(mmol/L)	4.20	4.20	1.30	9.70
Potassium	(mmol/L)	19.2	21.1	8.9	29.2
Actual osmolality	(mosm/kg)	1429.8	1360	399	2901
Predicted osmolality	(mosm/kg)	1422.5	1302	302	2940

Table 1. Summary statistics for urine concentration of relevant osmolytes evaluated using Konelab 30i, Thermo Scientific[®]; Cergy Pontoise, France (Urea, Sodium, Glucose) and the molybdate method (Potassium).

Model	Sodium (mmol/l) [95% CI]	Urea (mmol/l) [95% CI]	Glucose (mmol/l) [95% CI]	AIC _c value
1	1.05320 [0.22819 – 1.87821]	1.25252 [1.07350 – 1.43155]	66.72193 [21.09324 – 112.35062]	843.551
2	Not fitted	1.22839 [1.04243 – 1.41435]	101.78429 [63.74247 – 139.82611]	847.524
3	1.781978 [1.08258 – 2.48138]	1.46643 [1.35722 – 1.57564]	Not fitted	856.3768
4	Not fitted	1.701341 [1.64298 – 1.77171]	Not fitted	876.9481
5	Not fitted	Not fitted	339.9172 [319.361 – 360.473]	926.2244

Table 2. Summaries of the 5 best models. The difference between the AICC values of the first and the second model was greater than 2, which is basis for selecting the first model over the second model (Burnham, 2002). 95% CI: 95% confidence interval.