

MONITORING THE VITAMINS A AND E CONTENT IN COMPOUND FEEDS AND PREMIXTURES

PRAĆENJE SADRŽAJA VITAMINA A I E U KRMNIM SMJESAMA I PREDSMJESAMA

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SUMMARY

Vitamins A and E contents in compound feeds, supplementary feedstuffs and premixtures sampled in the years 2004-2006 were analyzed (288 samples). The obtained results were compared with producer declarations and requirements presented in dietary regulations and recommendations. On the average, the vitamin A contents in compound feeds for broiler chickens, laying hens, turkeys, piglets, fattening pigs and sows were close to the recommended values. In two of the analyzed compound feeds the maximum limit of 13,500 IU/kg of vitamin A was slightly exceeded, though it remained within the expanded uncertainty of analytical method. The levels of vitamin E in supplementary feedstuffs and premixtures confirm the fact that manufacturers practice supplementing feedstuffs with this vitamin whose addition may be sometimes higher than the dietary recommendations (improving dietetic value and storage possibility of meat, anti-stress activity). The studies revealed a total of 3.1% of cases in the years 2004-2006 (3.8% of cases in the years 2004-2008) when the vitamins A and E content was not consistent with the manufacturer's declaration. Regarding the vitamins A and E content, the quality of domestic feed products should be considered as good.

Key words: vitamins A and E, compound feed, supplementary feedstuff, premixture

INTRODUCTION

A and E vitamins are commonly added to compound feeds. In case of vitamin A some limitations have been introduced concerning its use and the maximum amount of its content in compound feeds has been established. According to the existing regulations, the maximum vitamin A content in compound feeds for chickens, ducks, turkeys, as well as those used in lamb, fattening pigs and beef cattle production amounts to 13,500 IU/kg, except in

compound feeds for young animals. The maximum content of vitamin A for slaughter calves was established at 25,000 IU/kg. For the remaining animals, no maximum share of vitamin A in compound feeds has been established.

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Regulation No 1831/2003 recognizes vitamins A and E as dietary additives, category 3a – vitamins, pro-vitamins and chemically well-defined substances of similar activity. Official monitoring of animal feeds which is in compliance with the EU regulations concerning, among others, vitamin content was introduced in Poland in 2004. The present study shows the results of vitamin A and E monitoring in animal feeds in the years 2004-2006.

Vitamins A and E are added to compound feeds in the form of premixtures. Differences in the vitamins A and E content in compound feeds may result from their low stability during the processes of thermobaric treatment and storage, especially in case of vitamin A (Van der Poel and Gadiant, 1997; Jaśkiewicz et al. 1997). The study aimed at acquiring data concerning the vitamins A and E content in domestic feed mixtures. The obtained results were compared with recommended levels.

MATERIAL AND METHODS

In the years 2004-2006 288 specimens of compound feeds and supplementary feed mixtures (concentrates and farmer's premixtures), as well as premixtures were collected by official samplers from regional veterinary inspectorates everywhere in Poland, and were next delivered to the National Feed Laboratory for the examination of their vitamin A and E content. The analyses were performed with the use of high-performance liquid chromatography (HPLC), in compliance with the Commission Directive (2000/45/EC). The validation parameters of the methods are presented in Table 1. The results

were interpreted by means of extended uncertainty of the method. The results were compared with the manufacturer's declaration, allowing for acceptable technical deviations defined by the MARD regulations (2007) and uncertainties of test methods (Korol et al., 2008). In case of exceeding the maximum vitamin A content, the result was interpreted as inconsistent with the regulation when the bottom of uncertainty range was higher than the maximum content. The results of the examination were regarded as inconsistent with the manufacturer's declaration when the upper limit of uncertainty range of the result was lower than the bottom limit of technical tolerance defined by the regulations. The results were statistically analyzed and mean values and standard deviations were calculated.

RESULTS AND DISCUSSION

The mean vitamin A content in compound feeds for broiler chickens amounted to 8880 IU/kg and was lower than the recommended addition levels by ca. 10% (Poultry Feeding Standards, 2005). In compound feeds for turkeys mean values of this vitamin were higher by ca. 10% in comparison to the recommended values. It should be noted that in one of the analyzed samples the maximum vitamin A content was slightly exceeded in compound feeds for turkeys (14,600 IU/kg in comparison with the maximum limit of 13,500 IU/kg), yet within the limits of the method's uncertainty. The share of vitamin A in compound feeds for laying hens amounted to 9,590 IU/kg on the average and was in compliance with the recommended level of this vitamin (Poultry Feeding Standards, 2005).

Table 1. Validation parameters of the HPLC methods used for vitamins A and E determination

Tablica 1. Parametri valjanosti HPLC metoda za određivanje vitamina A i E

Type of feed - Vrsta krmiva	Validation parameter - Parametar valjanosti	Vitamin A	Vitamin E
Compound feed Krmna smjesa	Quantitative limit of determination (LOQ) Kvantitativna granica određivanja	900 IU/kg	6 mg/kg
	Intermediate precision - Srednja točnost	5.2%	3.0%
	Recovery rate - Brzina oporavka	96.0%	96.7%
	Extended uncertainty - Produžena kolebljivost	16%	12%
Premixture - Predsmjesa	Intermediate precision - Srednja točnost	3.4%	3.4%
	Recovery rate - Brzina oporavka	95.2%	96.4
	Extended uncertainty - Produžena kolebljivost	14%	12%

The vitamin A content in the analyzed compound feeds for piglets amounted to 12,800 IU/kg and was higher by ca. 20% in reference to the recommended addition of this vitamin in Feeding Standards for Pigs (1993). Manufacturers usually use the so-called technological surpluses of vitamin A, due to its low stability during the commonly applied processes of thermobaric treatment and storage (Van der Poel and Gadiant, 1997).

The vitamin A content determined in compound feeds for fattening pigs and sows turned out to be close to the maximum values of recommended vitamin A addition quoted in Standards (1993), yet the maximum content of 13,500 IU/kg was not exceeded.

The average vitamin E content in compound feeds for broiler chickens amounted to 43.8 mg/kg, which was higher than the recommendations defined in Poultry Feeding Standards (2005). In compound feeds for turkeys, the average share of

this vitamin was also higher, by ca. 20%, than the recommended amount. The vitamin E content in feed mixtures for laying hens amounted to 32.0 mg/kg on the average and was higher than the mean addition recommended in the Standards by ca. 20%. All the tested samples of compound feeds revealed values higher than those recommended by the manufacturers.

The vitamin E content in compound feeds for piglets was 99.7 mg/kg on the average, with high diversity, and was higher by more than 50% than the addition of this vitamin recommended in Pig Feeding Standards (1993). As a rule, manufacturers of feed mixtures declared values higher than those recommended. The share of vitamin E determined in compound feeds for fattening pigs and sows were higher by 25 to 100%, by 50% on the average, than the recommended addition of this vitamin quoted in the Pig Feeding Standards (1993), (Table 2).

Table 2. The vitamins A and E content in compound feed (n=96)

Tablica 2. Sadržaj vitamina A i E u krmnim smjesama (n=96)

Type of compound feed - Vrsta krmne smjese	Vitamin A, IU/kg From-to X SD	Vitamin E, mg/kg From-to X SD
Compound feed for poultry - Krmna smjesa za perad		
- broiler chickens - pilići u tovu	6670 – 12200 8880 2040	27.0 – 69.5 43.8 9.8
- turkeys - pure	8300 – 14600 11800 2750	49.7 – 65.4 59.6 7.3
- laying hens - kokoši nesilice	5000-12500 9590 3223	16.9-58.7 32.0 15.6
Compound feed for pigs - Krmna smjesa za svinje		
- piglets - prasad	8590-14670 12800 2853	41.7-143 99.7 35.4
- fattening pigs - tovne svinje	7000-9500 8250 1767	53-67.1 60.1 10.0
- sows - krmače	10800-11500 11150 495	82-101 92.1 13.5

Table 3. The vitamins A and E content (α -tocopherol acetate) in supplementary feedstuff (n=80)

Tablica 3. Sadržaj vitamina A i E (α -tocopherol acetate) u dopunskom krmivu

Type of supplementary feedstuff - Vrsta dopunskog krmiva	Vitamin A IU/kg From-to X SD	Vitamin E, mg/kg From-to X SD
Supplementary feedingstuff for poultry - Dopunsko krmivo za perad		
- 10% mixtures	59000-146900 95400 34500	99-445 271 143
Supplementary feedingstuff for pigs - Dopunsko krmivo za svinje		
- 10% for fattening pigs - 10% za svinje u tovu	22600-72300 41162 21300	96-275 174 48,7
- 5% for fattening pigs - 5 % za svinje u tovu	111100-126000 118850 10536	147-671 409 170
- 4% for piglets - 4% za prasad	214000 – 426000 346000 37400	1500 – 3000 2070 560
- 5% for sows - 5% za krmače	215600-250000 210300 7495	700-1700 1200 307

Table 4. The vitamins A and E content (α -tocopherol acetate) in premixtures (n=112)

Tablica 4. Sadržaj vitamina A i E (α -tocopherol acetate) u predsmjesama (n=112)

Type of premixture - Vrsta predsmjese	Vitamin A, IU/kg From-to X SD	Vitamin E, g/kg From-to X SD
Premixtures for poultry - Predsmjese za perad		
- broiler chicken (0.5%) - pilići u tovu (0,5%)	2154500-2586600 2371100 575000	6.5 – 7.9 7.2 1.7
- laying hens (1%) - kokoši nesilice (1 %)	956000- 1245000 1193000 179000	2.15 – 2.43 2.32 0.36
- laying hens (0.5%) - kokoši nesilice (0,5%)	1632000-1645000 1638000 2300	4.8-5.4 5.1 0.4
- turkeys (0.5%) - pure (0,5%)	1885000 - 2314000 2155800 207000	3.7 – 4.5 4.1 0.55
Premixtures for pigs - Predsmjese za svinje		
- fattening pigs (0.5%) - svinje u tovu (0,5%)	1432000 – 1838000 1675000 187000	2.45 – 6.63 5.15 1.78

The results of control analyses confirm a tendency to increase the addition of vitamin E in compound feeds for poultry and pigs. Observed elevated values may also result from the presence of vitamin E in some feed materials, such as plant oils. The benefits of increased additions of vitamin E in compound feeds have been long discussed in research studies (Villaverde et al., 2004; Kotarbińska and Grela, 1995). The results of such analyses have been implemented in animal feeding in recent years. Vitamin E plays a role of an antioxidant in the organism, it acts as an anti-depressant, improves the flavor and storage durability of the products and is one of the factors affecting the production of the so-called functional food (Weiss and Wyatt, 2003; Al-Mabruk et al., 2004; Koreleski and Świątkiewicz, 2007).

The results of official monitoring aimed at studying the vitamins A and E content in domestic feeds, performed in the years 2004-2006 by the National Feed Laboratory and in the following years (2007-2008) by Regional Veterinary Laboratories authorized to do research within official feed control, confirmed the satisfactory quality of compound and supplementary feed mixtures, as well as premixtures in reference to the vitamins studied (Table 5). In the years 2004-2006 nineteen cases of inconsistency concerning the declared levels of vitamins A and E were recorded out of 619 analyzed samples (3.1%). In the years 2004-2008 the percentage of feeds which did not meet the requirements was 3.8%.

Table 5. Evaluation of vitamin A and E content in compound feed (CF), supplementary feedstuff (SF) and premixtures during official feed supervision in Poland in 2004-2008

Tablica 5. Ocjena sadržaja vitamina A i E u krmnim smjesama (CF), dopunskom krmivu (SF) i predsmjesama za vrijeme službene kontrole krmiva u Poljskoj od 2004-2008

Item – Stavke	Year - Godina					
	2004	2005	2006	2007	2008	2004- 2008
Vitamin A and E in premixtures Vitamin A i E u predsmjesama						
- total - ukupno (n)	60	64	28	20	18	190
- not meeting requirements (n) ne udovoljava zahtjevima (n)	1	5	3	1	0	10
- not meeting requirements (%) ne udovoljava zahtjevima (%)	1.7	7.8	10.7	5.0	0	5.3
Vitamin A and E in CF and SF:						
- total - ukupno (n)	94	190	183	65	65	597
- not meeting requirements (n) ne udovoljava zahtjevima (n)	1	7	2	6	4	20
- not meeting requirements (%) ne udovoljava zahtjevima (%)	1.1	3.7	1.1	9.2	6.2	3.4
Vitamin A and E in feed products: Vitamin A i E u krmivima						
- total - ukupno (n)	154	254	211	85	83	787
- not meeting requirements (n) ne udovoljava zahtjevima (n)	2	12	5	7	4	30
- not meeting requirements (%) ne udovoljava zahtjevima (%)	1.3	4.7	2.4	8.2	4.8	3.8

CONCLUSION

The results of vitamins A and E study were significantly higher than animal requirements. Manufacturers declare various amounts of vitamins present in their feed products, depending on the species, age and performance of the animals. The source of differences concerning the results may also be the method applied, the way of collecting samples, low homogeneity of a sample related to the way of securing vitamins in vitamin preparations or the influence of the processing technology on vitamins durability.

Therefore, an authorized inspector assessing the results of studying the vitamins content in feeds and their consistence with the manufacturer's declaration should take into consideration both the acceptable technical tolerance and the uncertainty of a test method. In conclusion, the quality of domestic feed products concerning their vitamins A and E must content be regarded as fine.

REFERENCES

1. Al-Mabruk, R. M., Beck N. F. G., Dewhurst, R. J. (2004): Effects of silage species and supplemental of vitamin E on the oxidative stability of milk J. Dairy Sci. 87 (2), 406-412.
2. Commission Directive (2000): No 2000/45/EC establishing Community methods of analysis for the determination of vitamin A, vitamin E and tryptophan in feedingstuffs. OJ L 174, 13.7.2000, p.32.
3. Koreleski, J., Świątkiewicz, S. (2007): Dietary Supplementation with plant extracts, xanthophylls and synthetic antioxidants: Effect on fatty acid profile and oxidative stability of frozen stored chicken breast meat. J. Anim Feed Sci. 16, 463-471.
4. Kotarbińska, M., Grela, E. (1995): Feed additives for pigs., The Kielanowski Institute of Animal Physiology and Nutrition, 05-110 Jabłonna, Poland, pp. 37-56
5. Jaśkiewicz, T., Matyka, S., Korol, W. (1998): An influence of storage conditions and choline chloride on stability of vitamin A i E in premixtures (in Polish). Biul. Nauk. Przem. Pasz. 37 (1/2), 5-13.
6. Korol, W., Rubaj, J., Bielecka, G. (2008): An interpretation system of feed analyses based on interlaboratory comparisons. Krmiva 50 (6), 319-327.
7. Pig Feeding Standards (1993): The Kielanowski Institute of Animal Physiology and Nutrition, 05-110 Jabłonna, Poland
8. Regulation of MARD (2007): Regulation of Ministry of Agriculture and Rural Development on tolerance limits of nutrients and feed additives (in Polish), Polish Official Law Journal, No 20, pos. 120, 2007.
9. Smulikowska, S., Rutkowski, A. (2005): Feeding requirements and nutritive value of feedingstuffs. Poultry Feeding Standards. The Kielanowski Institute of Animal Physiology and Nutrition, 05-110 Jabłonna, Poland
10. Van der Poel, A. F. B., Gadiant, M. (1997): Effects of expander processing on the recovery of feed additives. In: A.F.B Van der Poel (Editor). Expander Processing of Animal Feeds. Feed Processing Centre, Wageningen 1997, pp. 49-56.
11. Weiss, W. P., Wyatt, D. J. (2003): Effect of dietary fat and vitamin E on α -tocopherol in milk from dairy cows. J. Dairy Sci. 86 (11), 3582-3591.
12. Villaverde, C., Cortinas, L., Barroeta, A. C., Martín-Orúe, S. M., Baucells, M. D. (2004): Relationship between dietary unsaturation and vitamin E in poultry. J. of Animal Physiology and Animal Nutrition 88 (4), 143-149.

SAŽETAK

Analiziran je sadržaj vitamina A i E u krmnim smjesama, dodacima i predsmjesama u uzorcima od 2004. do 2006. godine (288 uzoraka). Dobiveni rezultati uspoređeni su s deklaracijama proizvođača i pravilnicima i preporukama za hranidbu. U prosjeku sadržaj vitamina A i E u krmnim smjesama za piliće u tovu, kokoši nesilice, purane, praščiće, tovne svinje i krmače bio je vrlo blizu preporučenih vrijednosti. U dvije od analiziranih krmnih smjesa maksimalna granica od 13,500 IU/kg vitamina A bila je neznatno prekoračena, iako je ostala unutar

povećane kolebljivosti analitičke metode. Razine vitamina E u dodatnim krmivima i predsmjesama potvrđuju činjenicu da proizvođači obično dodaju ovaj vitamin krmivima ponekad u većoj količini od preporučene (poboljšanje hranidbene vrijednosti i mogućnost spremanja mesa, protustresna aktivnost). Istraživanjima je otkriveno ukupno 3,1% slučajeva u godinama 2004-2006. (3,8% slučajeva 2004-2008. godine), kada sadržaj vitamina A i E nije odgovarao deklaraciji proizvođača. Sadržaj vitamina A i E, te kakvoću domaćih krmiva treba smatrati dobrima.

Ključne riječi: Vitamini A i E, praćenje, krmna smjesa, dopunsko krmivo, predsmjesa

narudžbenica

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