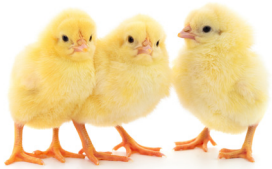
PHI-CHROME™
CHROMIUM PROPIONATE



Technical Bulletin
Information from Phibro Technical Services

Phi-Chrome™ Chromium Propionate

Phi-Chrome Chromium Propionate from Phibro Animal Health Corporation is included in our portfolio of mineral and nutrition specialty products. Due to only minimal amounts of inorganic chromium being absorbed from the diet (0.5 - 2.0%)[1], supplementation with organic chromium helps ensure increased bioavailability of this essential nutrient.[2]

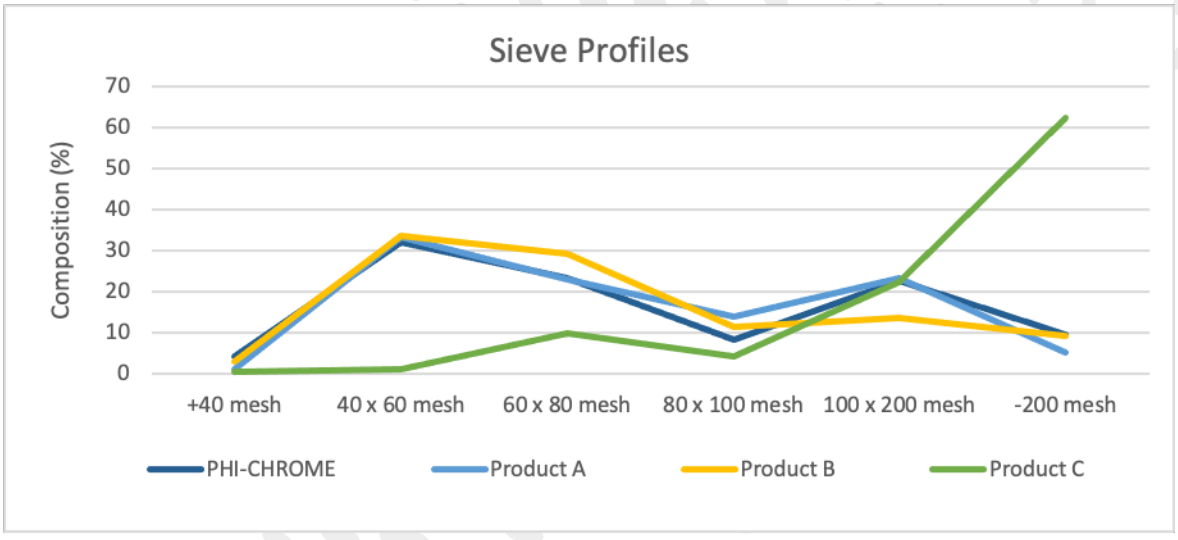
The approach to ensuring Phi-Chrome minerals meet the quality standards our customers expect is through Phibro's Dynamic Quality Assurance® (DQA®) process. Our DQA process monitors the efficacy and safety of Phibro ingredients through detailed, routine analysis based on our FSMA compliant food safety plan. The process takes analysis beyond testing of the major element (Cr) and contaminants to a 162-point elemental fingerprint scan, along with other quantitative and qualitative testing. Phibro's DQA process helps to ensure a high quality, consistent product for our customers every time.

Physical Characteristics

Mineral manufacturing processes can vary significantly, affecting mineral quality and consistency. Phibro's DQA process takes a skilled approach at fully understanding the mineral manufacturing process and ultimately the performance of the final ingredient.

Sieve profiles are utilized to identify the physical features of mineral products with the same target element but manufactured differently. Figure 1 below illustrates the sieve profiles of Phi-Chrome and three other competitive products. Similar sieve profiles were reported for Phi-Chrome Chromium Propionate, Product A and Product B, while Product C reported a much different profile compared to the other three chromium products.

Figure 1. Comparison of a Phi-Chrome Chromium Propionate Sieve Profile Versus Three Competitive Chromium Propionate Products. Phibro Analysis, 2020.



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Chemical Characteristics

Inductively Coupled Plasma Mass Spectrometry (ICP-MS) provides a detailed elemental analysis to identify and quantify the major elements present in a material. Analysis was performed on Phi-Chrome and three competitive products. Similar properties were reported for Phi-Chrome and two of the competitive products, with slight differences being reported in the final competitive product tested. The similarities, and differences, are primarily attributed to the carrier ingredient and not the primary element of interest (Cr; Table 1).

Table 1. Comparison of ICP-MS for Phi-Chrome Chromium Propionate versus three competitive chromium propionate products. Phibro analysis, 2020.

Element	Phi-Chrome 10x: Chromium Propionate	Product A	Product B	Product C
Cr (%)	0.433	0.421	0.467	0.415
Ca (%)	37.0	38.5	37.5	0.168
Mg (%)	0.372	0.148	0.205	0.045
Na (%)	0.163	0.237	0.043	0.127
Fe (%)	0.119	0.056	0.115	0.210
Zn (%)	0.103	0.001	0.004	0.001
S (%)	0.069	0.084	0.059	< 0.030
Mn (%)	0.059	0.015	0.019	0.005
K (%)	0.031	0.008	0.008	0.085
P (%)	0.007	0.008	0.015	0.007
Cu (%)	0.003	0.020	< 0.001	0.001

Identification of heavy metals is also important to assist with understanding the compositional characteristics of different chromium propionate products. Phi-Chrome Chromium Propionate and Products A and B have similar heavy metal concentrations in the four metals of interest, while elevated levels were reported in Product C (Table 2).

Table 2. Heavy metal analysis of raw materials comparing Phi-Chrome Chromium Propionate with three competitive chromium products. Phibro analysis, 2020.

Heavy Metals (Typical Analysis)	Phi-Chrome 10x: Chromium Propionate	Product A	Product B	Product C
As (ppm)	< 0.500	< 0.500	< 0.500	0.823
Cd (ppm)	< 0.250	< 0.250	< 0.250	< 0.250
Hg (ppm)	< 0.050	< 0.050	< 0.050	< 0.050
Pb (ppm)	< 2.50	< 2.50	< 2.50	6.24

Compound Structure and Purity

Along with the elemental analysis, X-ray Diffraction (XRD) and Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) support the purity of Phi-Chrome Chromium Propionate. The XRD data illustrated in Figure 2 indicates no major differences in the crystalline structure of Phi-Chrome Chromium Propionate versus Product A, the leading competitor on the market. The TOF-SIMS data is used to identify compounds and their components by mass. The results in Figure 3 indicate chromium propionate was detected in all samples (green box), with Phi-Chrome reporting a reduced number of peaks, an indication of stability and purity.

Figure 2. Comparison of XRD for Phi-Chrome Chromium Propionate and the leading competitor product. Missouri University of Science Technology, 2020.

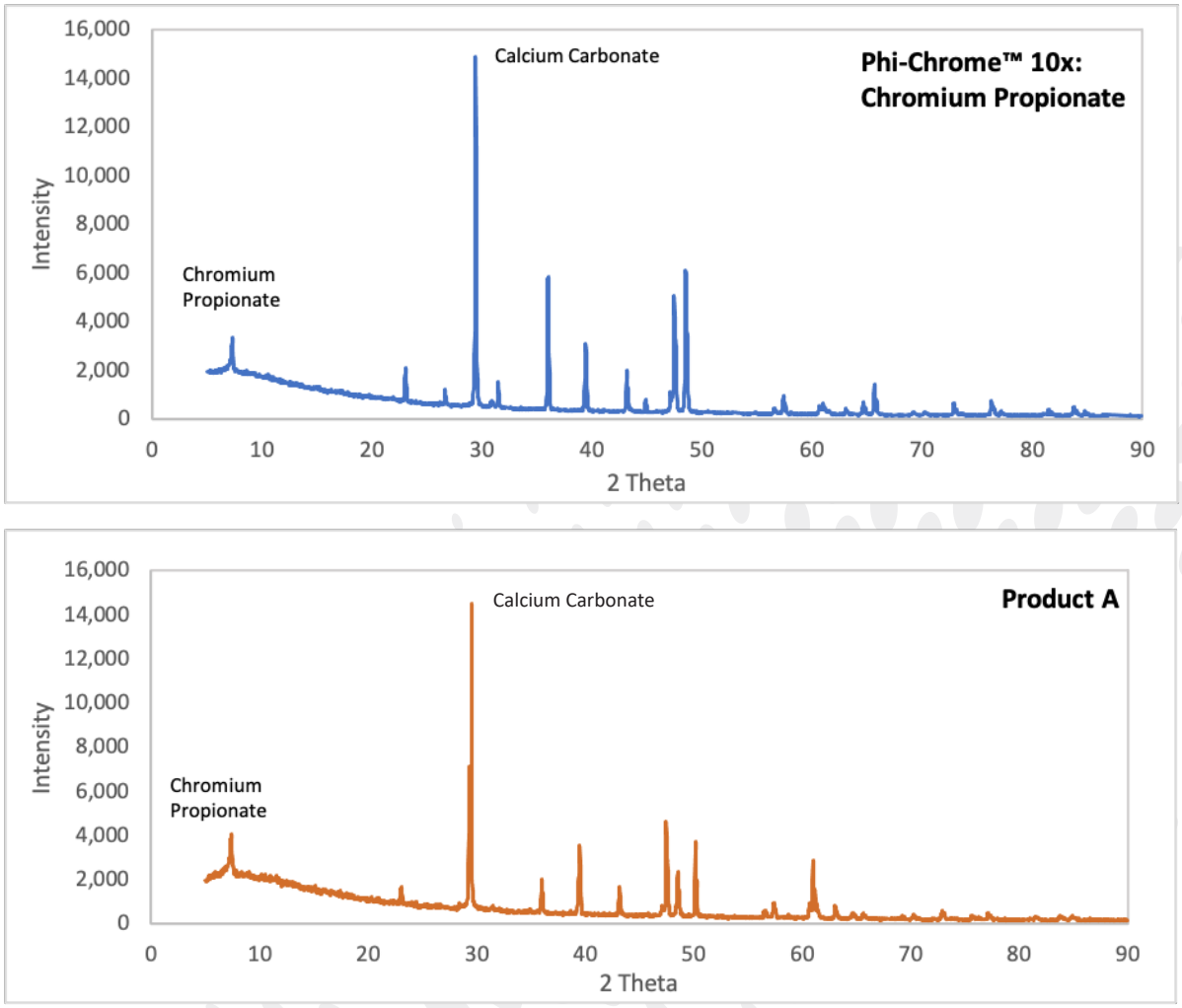

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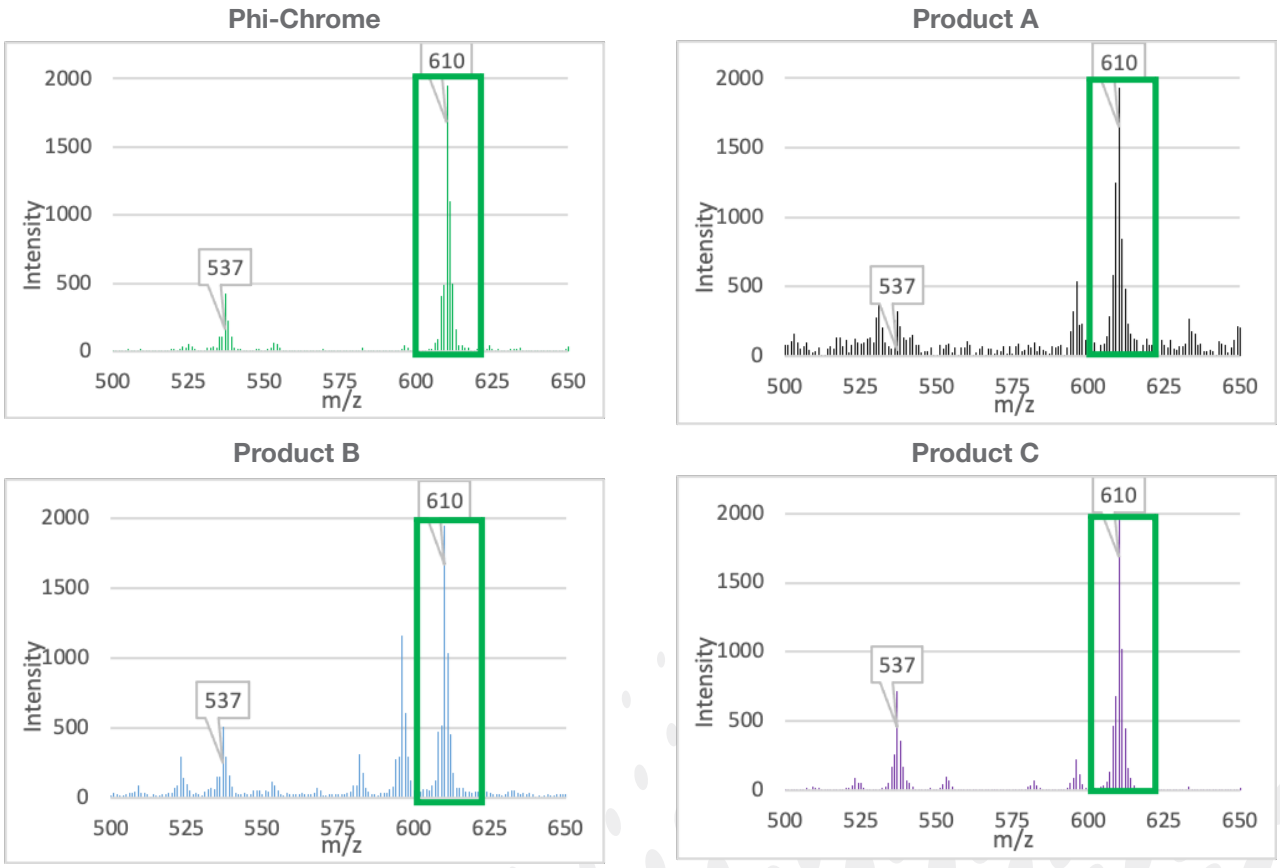
Figure 3. Comparison of TOF-SIMS for Phi-Chrome Chromium Propionate and three competitive chromium propionate products. Eurofins EAG, 2020.



Conclusion

Phibro Animal Health Corporation understands the risks associated with raw mineral materials and their manufacturing processes. Phibro's DQA process , used for for Phi-Chrome Chromium Propionate, helps ensure a high quality, consistent product is distributed to our customers every time.

DQA analysis determined the following for Phi-Chrome Chromium Propionate:

- Similar physical characteristics as Products A and B
- Similar chemical characteristics as Products A and B
- Similar XRD results as Product A
- TOF-SIMS data indicates chromium propionate is present in all samples with Phi-Chrome having a reduced number of peaks, an indication of increased stability and purity.

Phibro has exclusive distribution rights to this organic chromium propionate source.

References

Anderson, R.A. and A.S. Kozlovsky. Chromium intake, absorption and excretion of subjects consuming self-selected diets. Am. J. Clin. Nutr. Vol. 41 (1985) 1177-1183.

Spears, J. Chromium in Animal Nutrition. Salt Institute Newsletter First Quarter (2010) North Carolina State University.

This information has been prepared for industry technical professionals.