



Potencial do DDG na nutrição de peixes

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O que é o DDG



- **Termo em inglês “Dried Distillers Grains”**

- Grãos secos de destilaria
- USA desde a década de 1940



Projeção de produção Brasileira de DDG



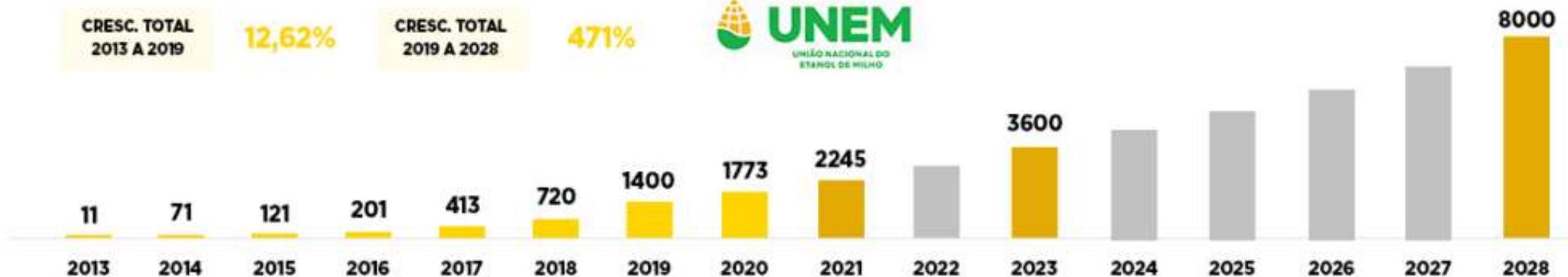
HISTÓRICO E PROJEÇÃO DA PRODUÇÃO DE ETANOL DE MILHO NO BRASIL EM MILHÕES DE LITROS DE ETANOL

CRESC. TOTAL
2013 A 2019

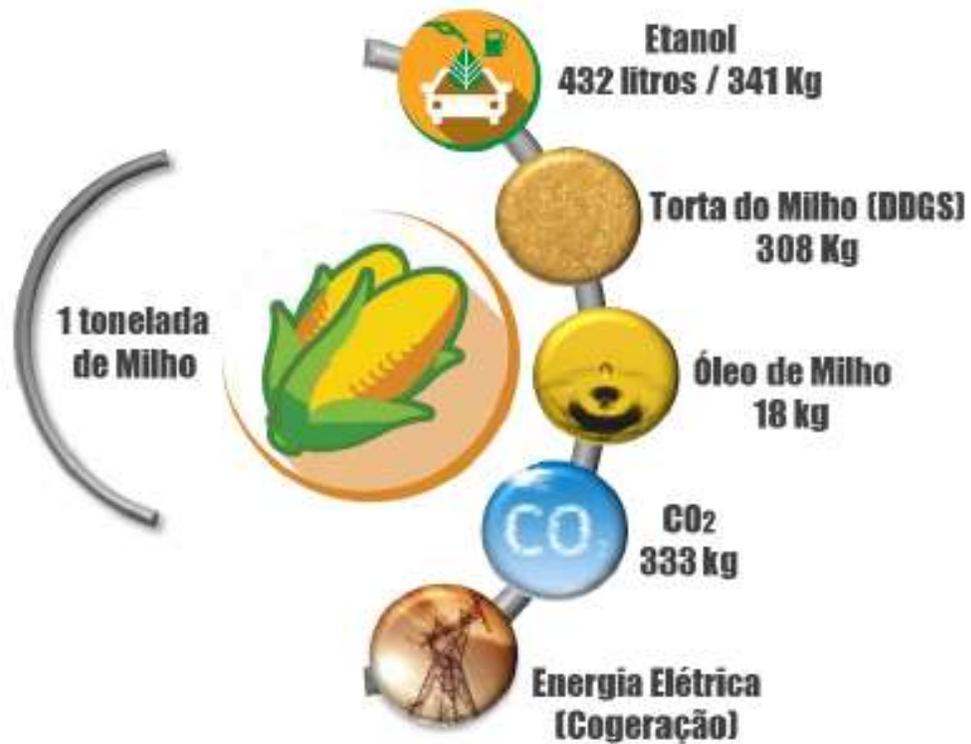
12,62%

CRESC. TOTAL
2019 A 2028

471%



Produção de Etanol a partir do Milho



Esta Safra:

3000 M m³ etanol

2140 M ton DDG

Safra 2028

8000 M m³ etanol

5700 M ton DDG

Tipos de produtos

- WDG e WDGs



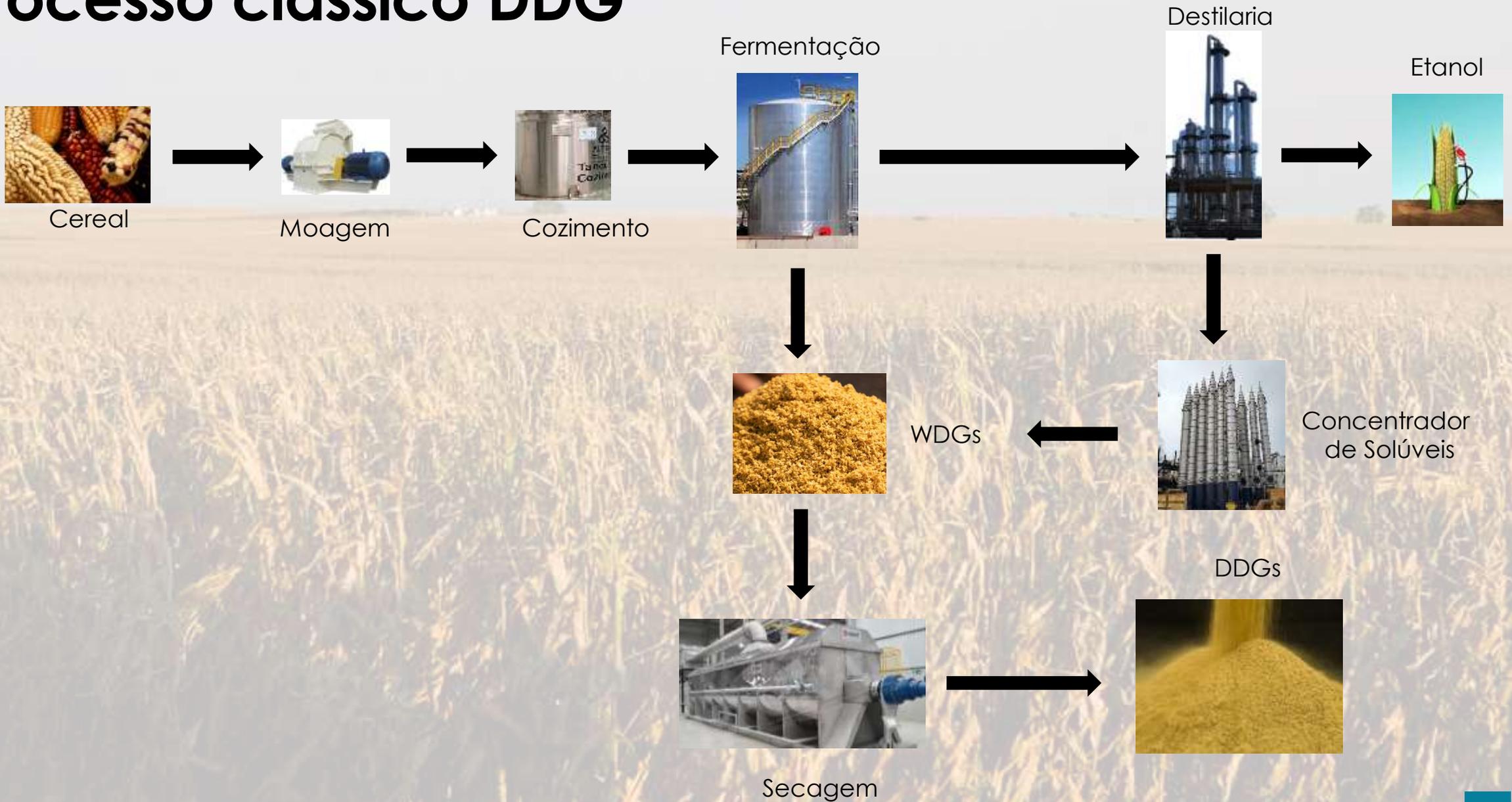
- DDG e DDGs



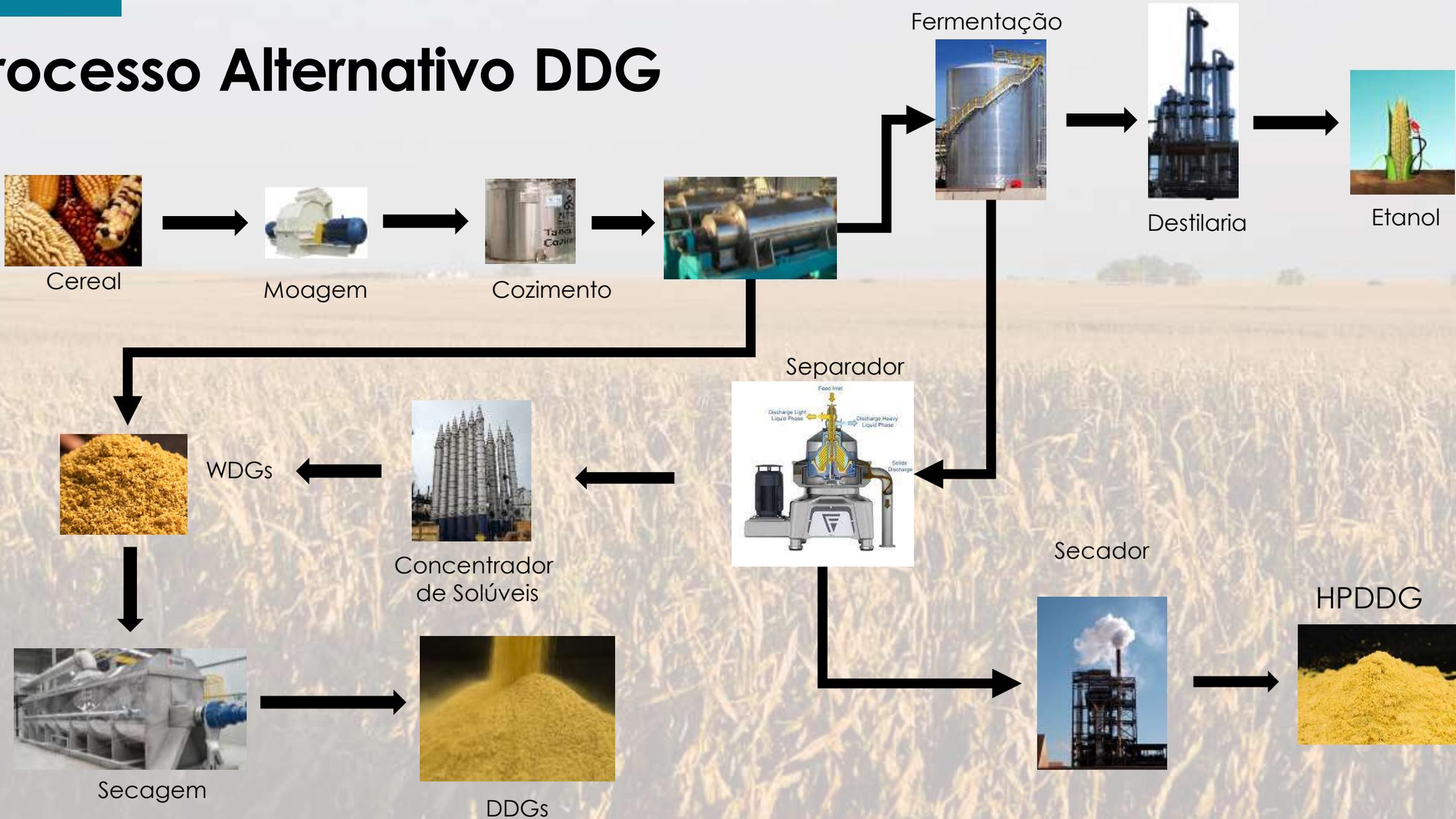
- HPDDG



Processo clássico DDG



Processo Alternativo DDG



Diferença entre os produtos

- Composição bromatológica
 - Bastante variável
 - Proteína bruta
 - Fibras
 - Extrato etéreo
 - Interfere na inclusão

	Média	Máximo	Mínimo
Matéria seca	89,44	96,60	77,80
Proteína bruta	31,74	55,70	15,50
Fibra detergente neutro	46,71	66,80	21,30
Fibra detergente ácido	23,73	52,80	10,80
Extrato etéreo	11,91	28,70	1,17
Carboidratos não fibrosos	8,58	21,21	2,65
Nutrientes digestíveis totais	76,42	100,3	55,80

Fonte: Adaptado de ESALQLab.

Resultados na literatura



Avaliação do DDGS na alimentação da tilápia do Nilo (*Oreochromis niloticus*).

Tabela 2 Composição percentual das rações com níveis crescentes de DDGS na alimentação de tilápia do Nilo.

Ingredientes (%)	DDGS (%)				
	0	10	20	30	40
Farelo de soja	54,00	48,47	42,93	37,39	31,85
Milho moído	39,19	32,79	26,39	19,99	13,60
Fosfato bicálcico	3,37	3,15	2,92	2,71	2,48
Óleo de soja	1,87	3,18	5,73	7,66	9,59
Premix ¹	1,00	1,00	1,00	1,00	1,00
Sal comum	0,50	0,50	0,50	0,50	0,50
Calcário	0,06	0,19	0,33	0,46	0,60
BHT ²	0,01	0,01	0,01	0,01	0,01
DDGS	0,00	10,00	20,00	30,00	40,00
L-Lisina HCL	0,00	0,09	0,19	0,28	0,37
Total	100,00	100,00	100,00	100,00	100,00

Nutrientes (%)					
Matéria seca	100,00	100,00	100,00	100,00	100,00
Proteína bruta	28,00	28,00	28,00	28,00	28,00
Extrato etéreo	0,64	1,74	3,16	4,04	6,05
Energia bruta (Kcal/kg) *	4042,95	4228,61	4414,25	4599,91	4785,55
Energia digestível (Kcal/kg) *	3000,00	3000,00	3000,00	3000,00	3000,00
Matéria mineral	7,70	7,30	6,93	6,73	6,42
Fibra bruta	6,82	5,25	6,92	10,32	12,17

Avaliação do DDGS na alimentação da tilápia do Nilo (*Oreochromis niloticus*).

Tabela 6 Desempenho zootécnico de juvenis de tilápia do Nilo alimentados com dietas contendo níveis crescentes de DDGS.

Variável	Tratamentos (% inclusão de DDGS)					p-value
	0	10	20	30	40	
Peso inicial (g)	28.96±9.62	28.32±9.07	29.26±10.29	29.26±8.34	29.44±9.72	0.99
Peso final (g)	100.31±15.36	103.97±9.74	98.88±12.40	107.20±10.37	106.11±10.12	0.82
Ganho de peso (g)	71.35±6.09	75.65±12.97	69.27±2.31	77.94±4.81	76.67±4.50	0.40
Comp. Total (cm)	16.89±0.91	16.56±0.84	16.84±0.91	17.22±0.68	17.16±0.82	0.80
Comp. Padrão (cm)	13.81±0.78	13.53±0.85	13.91±0.89	14.32±0.64	14.08±0.89	0.71
Rendimento carcaça (%)	84.85±1.14 ^{ab}	81.13±2.85 ^b	85.67±1.34 ^a	85.82±0.94 ^a	84.72±1.08 ^{ab}	0.01
Rend. tronco limpo (%)	45.75±4.62	44.00±9.01	43.03±8.70	47.84±6.52	43.34±7.35	0.87
Índice hepatossomático	3.05±0.10 ^c	2.76±0.31 ^{bc}	2.57±0.18 ^{ab}	2.47±0.25 ^{ab}	2.24±0.16 ^a	0.00
Conversão alimentar	1.23±0.06	1.25±0.12	1.34±0.07	1.35±0.05	1.31±0.08	0.18
TCE	2.45±0.34	2.57±0.63	2.40±0.45	2.55±0.40	2.54±0.49	0.98
TEP	3.00±0.14 ^b	2.74±0.28 ^{ab}	2.59±0.13 ^a	2.61±0.10 ^a	2.72±0.17 ^{ab}	0.03
Eficiência alimentar	81.36±3.87	80.41±8.25	74.80±3.68	74.02±2.85	76.40±4.72	0.19
Fator de condição	2.08±0.19	2.30±0.21	2.07±0.21	2.10±0.09	2.10±0.11	0.33
GPD (g)	1.37±0.12	1.45±0.25	1.33±0.04	1.50±0.09	1.47±0.09	0.40
Sobrevivência (%)	87,50±12,58	90,00±8,16	97,50±5,00	90,00±8,16	100±0,00	0.17

(TEP): ganho de peso / quantidade de proteína consumida;

GRÃOS SECOS DE DESTILARIA COM SOLÚVEIS EM DIETAS PARA TILÁPIA-DO-NILO

Table 3. Formulation (%), calculated and analyzed composition of experimental diets.

Ingredients	Levels of replacement (%) ¹				
	0	10	30	50	70
Soybean meal	28.60	25.69	20.00	14.30	8.60
CDDGS	-	4.50	13.80	23.10	32.40
Poultry viscera meal	12.00	12.30	12.78	12.92	13.78
Corn gluten - 60	10.00	10.00	10.00	10.00	10.00
Corn	42.31	40.61	36.71	33.02	28.40
Soybean oil	0.02	0.11	0.50	0.99	1.44
L-lysine	-	0.10	0.20	0.28	0.38
DL-methionine	0.13	0.13	0.10	0.08	0.06
L-threonine	0.30	0.30	0.30	0.28	0.28
L-tryptophan	0.04	0.06	0.09	0.12	0.15
Dicalcium phosphate	3.80	3.78	3.76	3.78	3.70
CMC ²	2.00	1.61	0.97	0.32	-
Vitamin and mineral premix ³	0.63	0.63	0.63	0.63	0.63
Vitamin C ⁴	0.05	0.05	0.05	0.05	0.05
Antioxidant (BHT) ⁵	0.02	0.02	0.02	0.02	0.02
Salt	0.10	0.10	0.10	0.10	0.10

Table 4. Proximate composition and apparent digestibility coefficients (ADCS %)¹ of nutrients and energy of the test ingredients (% dry matter)².

	Ingredients	
	CDDGS	Farelo de soja
<i>Proximate composition</i>		
Dry matter	88.20 (42.64)	85.80 (63.34)
Crude protein	32.46 (90.04)	51.70 (94.42)
Crude fat	7.71 (85.53)	3.50 (85.22)
Crude fiber	11.58	6.01
Ash	5.01 (34.09)	6.24 (42.56)
Gross energy, kcal/kg ⁻¹	5090 (53.36)	4751 (69.77)

Amino acids

Alanine	2.45 (95.02)	2.10 (96.93)
Arginine	1.30 (94.81)	3.53 (99.03)
Aspartic acid	1.84 (93.64)	5.36 (99.07)
Glycine	1.15 (88.43)	2.21 (94.46)
Isoleucine	1.17 (93.49)	2.34 (97.10)
Leucine	4.33 (95.41)	3.87 (97.16)
Glutamic acid	6.09 (96.68)	8.87 (98.78)
Lysine	0.90 (87.23)	3.47 (97.92)
Cystine	0.51 (99.60)	0.49 (99.54)
Methionine	0.42 (94.45)	0.36 (94.28)
Phenylalanine	1.63 (94.51)	2.52 (98.08)
Tyrosine	1.00 (88.15)	1.53 (93.71)
Threonine	1.10 (86.78)	1.77 (95.25)
Tryptophan	0.05 (nd ³)	0.22 (89.39)
Proline	2.93 (94.71)	2.53 (96.06)
Valine	1.51 (93.11)	2.32 (96.21)
Histidine	0.90 (96.29)	1.32 (98.10)
Serine	1.58 (94.05)	2.37 (97.42)

Calcium and Phosphorus

Total calcium	0.17	0.24
Total phosphorus	0.27 (47.87)	0.47 (26.05)

¹ADCS = apparent digestibility coefficients; ²Values are means (n=3); ³nd = no detected.

Table 5. Growth performance and feed utilization of Nile tilapia fed experimental diets for 90 days¹.

Levels of replacement (%) ²	0	10	30	50	70	<i>P</i> -value
✓ Weight gain (g) ^a	177.60 ± 4.69	172.86 ± 6.24	170.76 ± 9.25	175.69 ± 4.77	179.70 ± 1.38	0.252
✓ Feed intake (g) ^b	171.05 ± 0.58	171.31 ± 1.14	170.91 ± 2.45	170.89 ± 1.31	172.00 ± 1.45	0.829
✓ Feed conversion ratio ^c	0.94 ± 0.03	0.99 ± 0.03	0.99 ± 0.05	0.97 ± 0.02	0.98 ± 0.01	0.601
✓ Protein efficiency ratio (%) ^d	3.63 ± 0.09	3.47 ± 0.12	3.44 ± 0.17	3.50 ± 0.09	3.43 ± 0.09	0.152
✓ Nitrogen retention (%) ^e	53.80 ± 2.90	48.57 ± 2.79	51.85 ± 4.66	50.60 ± 2.62	49.57 ± 2.68	0.227
✓ Energy retention (%) ^f	38.04 ± 7.07	36.34 ± 2.95	36.42 ± 4.36	32.67 ± 2.29	37.675 ± 1.696	0.413
✓ Visceral fat (%) ^g	2.47 ± 0.65	2.44 ± 0.52	2.45 ± 0.39	2.46 ± 0.63	2.45 ± 0.54	0.981
✓ Survival (%) ^h	100.00 ± 0	97.72 ± 4.55	97.72 ± 4.55	95.45 ± 5.25	97.72 ± 4.55	0.684

Table 7. Villus height (VH), crypt depth (CD) and villus:crypt ratio (V:C) of Nile tilapia fed experimental diets for 90 days¹.

Levels of replacement (%) ²	0	10	30	50	70	<i>P</i> -value
VH (µm)	288.10 ± 37.70	310.93 ± 15.53	303.50 ± 61.00	322.00 ± 40.30	313.50 ± 26.30	0.643
CD (µm)	23.07 ± 2.65	25.55 ± 1.29	25.00 ± 3.71	22.81 ± 3.07	21.83 ± 1.92	0.116
V:C	12.54 ± 1.38b	12.19 ± 0.88b	12.13 ± 1.63b	14.19 ± 1.57a	14.40 ± 1.18a	0.011 ←

¹Values presented as means ± standard. Means in the same row with different letters differ (*P*<0.05) by Tukey test. n= 180.

Integridade da mucosa intestinal

Dietas 50 e 70% DDGS

- Ausência de fatores antinutricionais (inibidores de tripsina, lectinas, gossipol)
- Baixos níveis de fitato.
- Presença da levedura também pode ter exercido influência.

A wide-angle photograph of a vast cornfield. The corn plants are in a late stage of growth, with their leaves and stalks turned a golden-brown color, indicating they are ready for harvest. The field stretches to a flat horizon under a clear, light blue sky. In the distance, a few small trees and a white building are visible on the horizon line.

Sem adição de Lisina

Table 1: Feed ingredients (g 100g⁻¹ diet, as is basis) and proximate composition of the experimental diets.

Ingredients	Experimental diets			
	Control	DDGS10	DDGS20	DDGS30
Fish meal ^a	65.00	61.38	57.77	54.16
DDGS ^b	0.00	10.00	20.00	30.00
Corn starch	25.50	19.57	13.63	7.67
Fish oil	6.00	5.55	5.10	4.67
Vitamin premix ^c	1.00	1.00	1.00	1.00
Mineral premix ^d	1.00	1.00	1.00	1.00
CMC ^e	1.00	1.00	1.00	1.00
Cr ₂ O ₃ ^f	0.50	0.50	0.50	0.50
Proximate composition ^g				
Dry matter (%)	89.24	89.14	88.84	88.54
Crude protein (%)	43.79	43.32	43.44	43.87
Crude lipid (%)	12.18	12.48	12.96	13.24
Crude ash (%)	9.34	9.32	9.41	9.34
Crude fibre (%)	1.24	1.78	2.36	2.98
NFE (%) ^h	22.69	22.25	20.67	19.12
DE (MJ/kg) ⁱ	17.42	17.43	17.45	17.47

Table 2 Growth performance, biometrical parameters and survival of rainbow trout fed the different experimental diets.

Parameters	Experimental diets			
	Control	DDGS10	DDGS20	DDGS30
Initial weight (g/fish)	19.87±0.49	19.88±0.55	19.87±0.59	19.89±0.36
Final weight (g/fish)	100.21±3.32 ^b	102.79±1.79 ^b	104.18±1.95 ^b	109.70±3.91 ^a
SGR (%/day)	1.93±0.04 ^b	1.95±0.03 ^{ab}	1.97±0.02 ^{ab}	2.03±0.06 ^a
CF	1.20±0.01	1.21±0.01	1.21±0.01	1.22±0.01
VSI (%)	11.56±0.68	11.41±0.50	11.18±1.08	11.14±0.89
HSI (%)	1.42±0.11	1.40±0.07	1.32±0.11	1.36±0.15
ISI (%)	1.01±0.06	1.05±0.09	1.06±0.10	1.07±0.11
SR (%)	97.3±2.3	96.0±4.0	98.7±2.3	98.7±2.3



- DDGs pode ser utilizado substituindo farinha de peixe sem prejuízos na performance para truta arcoíris
- DDGS Possui ganhos econômicos na sua utilização.

Table 1 Ingredient composition of practical diets with and without 30% distillers grains with solubles (DDGS) in combination with different protein sources

Ingredients	Diet 1 (control) (SBM + FM)	Diet 2 (DDGS + FM)	Diet 3 (DDGS + MBM)	Diet 4 (DDGS + SBM)
DDGS	–	30	30	30
FM	12	8	–	–
MBM	–	–	26	–
SBM	41	34	16	46
Wheat flour	33.3	16.5	18	11.8
Corn oil	3.3	2.1	1.2	2.5
Fish oil	2.4	1.4	0.8	1.7
Choline chloride	0.5	0.5	0.5	0.5
Mineral mix*	0.3	0.3	0.3	0.3
Vitamin mix†	0.2	0.2	0.2	0.2
Ascorbic acid‡	2	2	2	2
Di-calcium phosphate	2	2	2	2
CMC§	3	3	3	3

Table 4 Average weight (avg. wt.) gain, percent survival, feed conversion ratio (FCR), and specific growth rate (SGR) of tilapia fed practical diets with and without 30% distillers dried grains with solubles (DDGS) in combination with different protein sources*

	Diet 1 (control) (SBM +FM)	Diet 2 (DDGS +FM)	Diet 3 (DDGS +MBM)	Diet 4 (DDGS +SBM)
Avg. wt. gain (g)	65.4 ± 4.4a	60.5 ± 1.6ab	65.8 ± 5.9a	55.1 ± 2.3b
Survival (%)	98.8 ± 2.1a	100 ± 0.0a	100 ± 0.0a	98.8 ± 2.1a
FCR†	2.1 ± 0.2b	2.4 ± 0.1ab	2.3 ± 0.3ab	2.7 ± 0.2a
SGR (g/day)‡	0.86 ± 0.06a	0.80 ± 0.03ab	0.87 ± 0.08a	0.73 ± 0.03b
PER§	2.05 ± 0.16b	2.36 ± 0.11ab	2.29 ± 0.32b	2.69 ± 0.21a

*Averages are means of three replicate aquaria. Numbers within a row followed by different letters were significantly different ($P < 0.05$) by ANOVA.

Utilização de DDGS (30%) com Farinha de carne o ossos e Farinha de peixe.

- Não afeta o desenvolvimento;
- Possibilidade de substituição do Farelo de soja e Farinha de peixe na dieta de Tilápias;



Substituição da farinha de peixe por DDGs

EFFECT OF DIETARY GRADED LEVEL OF SUBSTITUTING DISTILLERS DRIED GRAINS WITH SOLUBLES INSTEAD OF FISH MEAL IN TILAPIA DIET

Table 2: Composition and chemical analysis of the experimental diets.

Ingredients (kg/ton)	T ₁ Control	T ₂ 25%	T ₃ 50%	T ₄ 75%	T ₅ 100%
Rice bran	240	240	240	240	240
Yellow corn	150	150	150	150	150
Fine wheat bran	200	200	200	200	200
Corn Gluten	50	50	50	50	50
Soybean meal	200	200	200	200	200
Fish meal, FM	150	112.5	75	37.5	0.00
DDGS	0	37.5	75	112.5	150
Vit. & Min. premix ⁽¹⁾	10	10	10	10	10
Total	1000	1000	1000	1000	1000
Total cost (LE) ⁽²⁾	4250	3900	3550	3200	2850
Chemical composition, % on dry matter basis:					
DM	89.33	89.15	89.59	89.45	88.47
OM	10.67	10.85	10.41	10.55	11.53
CP	27.86	27.10	26.05	25.01	24.32
EE	8.31	8.12	9.29	8.14	8.41
CF	6.5	7.5	5.5	8.5	6.5
Ash	8.92	8.77	9.16	8.92	9.02
NFE ⁽³⁾	48.41	48.51	50	49.43	51.75
GE, Kcal/100 g DM ⁽⁴⁾	462.2	460.7	463.84	456.82	456.87
Protein/Energy (P/E ratio) mg CP/Kcal GE ⁽⁵⁾	60.19	58.82	56.16	54.74	53.23

Table 3: Means of effect of feeding different levels of DDGS on final body weight (FW, g/ fish), total bodyweight gain (TWG, g/fish), average weight gain (AWG, g/fish/day), relative growth rate (RGR, %), specific growth rate, SGR, %/day), and survival rate (SR, %) of Nile tilapia reared in cages.

Treatment	FW	TWG	AWG	RGR	SGR	Survival (%)
Control	285.6 ^a	258.5 ^a	2.12 ^a	954.9 ^a	1.93 ^a	68.57
25% DDGS	284.5 ^a	257.4 ^a	2.11 ^a	950.8 ^a	1.92 ^a	68.74
50% DDGS	268.9 ^b	241.8 ^b	1.98 ^b	893.1 ^b	1.88 ^b	68.19
75% DDGS	270.9 ^b	243.8 ^b	1.99 ^b	900.3 ^b	1.89 ^b	67.68
100% DDGS	269.4 ^b	242.3 ^b	1.99 ^b	895.2 ^b	1.88 ^b	67.76
± SEM	1.634	1.634	0.013	6.036	0.005	-
P - value	0.0001	0.0001	0.0001	0.0001	0.0001	-

a and b: Means in each column have different letters are significantly different (P<0.05).

Table 12: Data of calculating the economic efficiency (EE, %) by feeding fish DDGS containing diets.

Treatment	FCR	Feed cost (LE/kg)	Cost of feed needed
Control	1.26	4.25	5.355
25%DDGS	1.26	3.9	4.914
50% DDGS	1.31	3.55	4.6505
75% DDGS	1.29	3.2	4.128
100% DDGS	1.28	2.85	3.648



Uso do HPDDG



Inclusão de HPDDG em dietas de Tilápia

Tabela 2 - Matérias-primas utilizadas nas dietas experimentais.

Ingredientes	Dietas experimentais (Kg)			
	Controle	HP-25	HP-50	HP-75
HPDDG	0.00	97.50	195.00	292.50
Farelo de soja	390.00	292.50	195.00	97.50
Glúten de Milho	65.00	65.00	65.00	63.00
Farinha de vísceras	75.00	80.00	90.00	100.00
Fubá Milho	170.00	180.00	200.00	203.90
Farelo Trigo	90.00	85.00	80.00	80.00
Quirera Arroz	70.00	80.00	80.00	80.00
Treonina	3.00	3.00	2.00	1.60
Caulim	70.50	49.90	21.50	4.50
Celulose	6.00	4.00	2.00	0.00
L – Lisina	0.00	0.00	1.00	2.00
DL – Metionina	1.50	1.00	0.50	0.00
Triptofano	0.50	0.60	1.00	1.00
Fosfato bicálcico	16.00	13.00	11.50	8.00
Óleo Soja	28.00	33.00	39.00	49.00
Calcário	4.00	5.00	6.00	6.50
Vit C	2.80	2.80	2.80	2.80
Sal comum	5.00	5.00	5.00	5.00
Premix vitam/min	2.50	2.50	2.50	2.50
BHT	0.20	0.20	0.20	0.20
Total	1,000	1,000	1,000	1,000

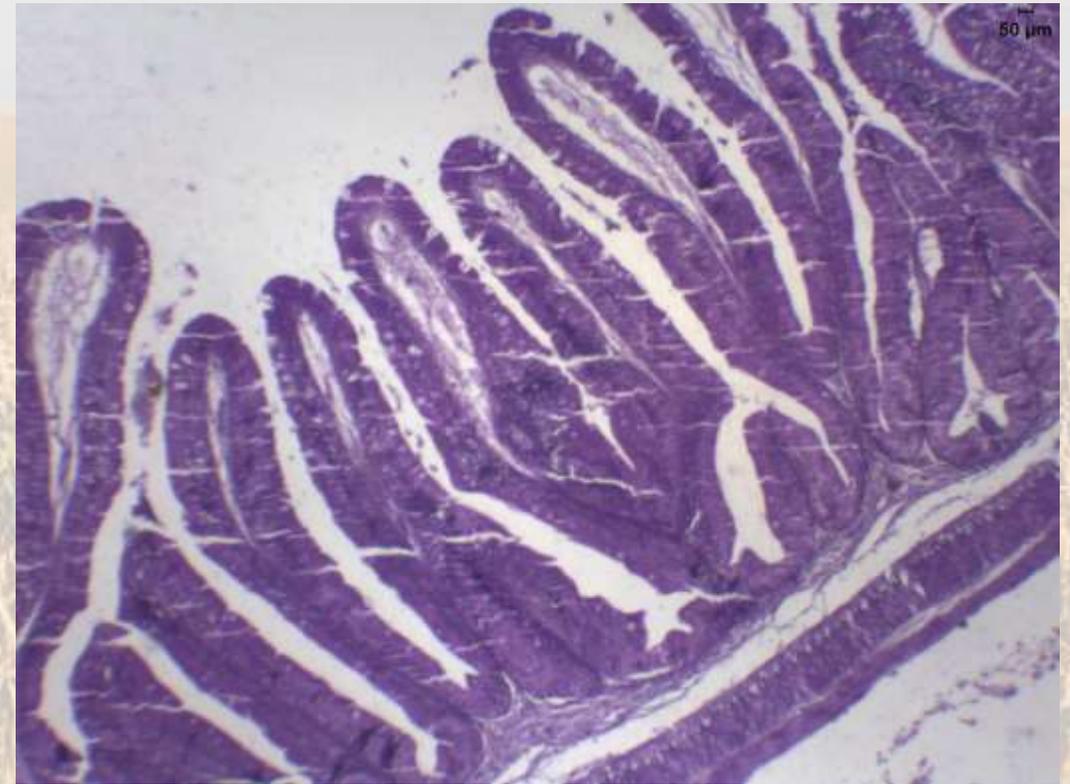
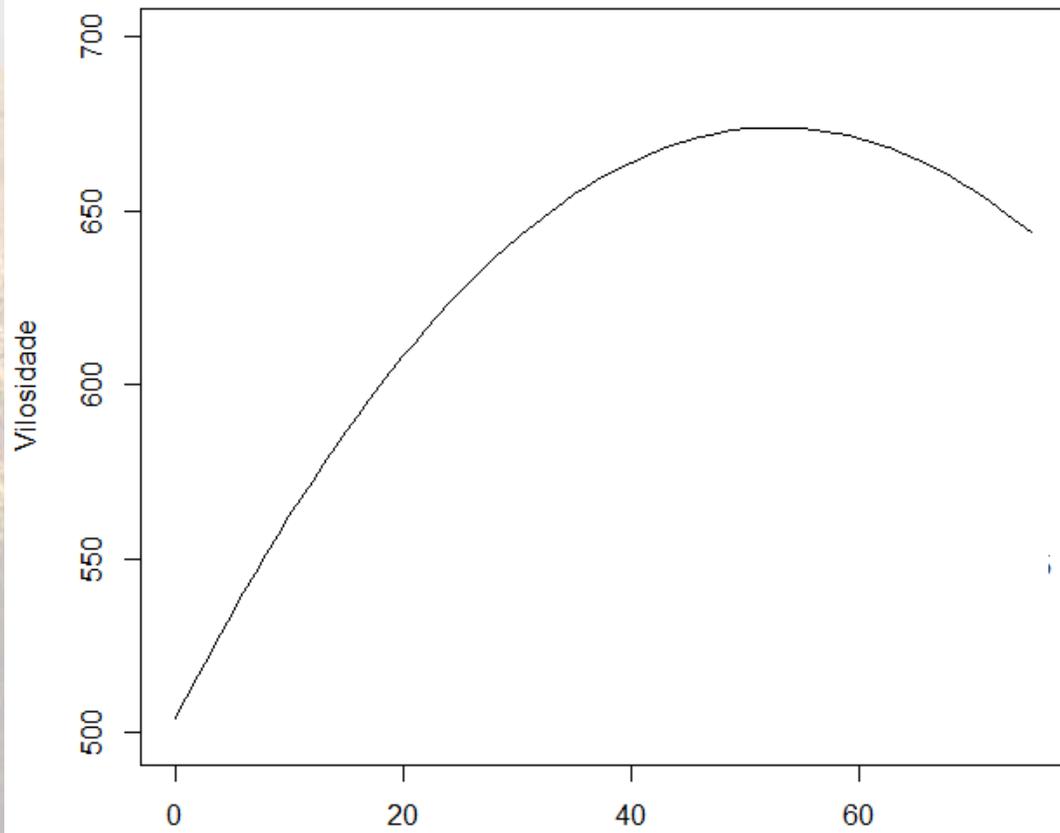
Tabela 3 - Composição calculada da dieta com base nas exigências da tilápia.

Composição	Nível de substituição (%)				Exigência
	Controle	HP-25	HP-50	HP-75	
Energia Digestível	3082,55	3056,39	3064,77	3055,90	3036,00
Proteína Digestível	27,21	26,98	27,04	26,96	26,81
Proteína Bruta	29,78	29,77	30,07	30,23	29,73
Fibra Bruta	3,94	3,92	3,90	3,91	3,65
Extrato Etéreo	5,32	5,94	6,71	7,88	3,00
Cálcio total	0,92	0,91	0,93	0,91	0,90
Fósforo Disponível	0,52	0,51	0,53	0,52	0,51
Metionina	0,54	0,53	0,53	0,53	0,52
Aminoácidos sulfurados	0,91	0,94	0,98	1,02	0,92
Lisina	1,66	1,54	1,54	1,55	1,53
Triptofano	0,30	0,30	0,32	0,31	0,30

Tabela 4. Peso médio inicial, peso médio final, ganho em peso, conversão alimentar e consumo de ração de acordo com a inclusão de HPDDG.

Parâmetros	HPDDG (%)			
	Controle	HP-25	HP-50	HP-75
Peso inicial	55,72	56,94	59,75	56,94
Peso final	534,94	576,08*	622,39*	515,57
Ganho de peso	479,22	519,14*	562,64*	458,63
Conversão alimentar	1,231	1,174	1,154	1,240
Consumo de ração	637,36	706,03*	725,81*	646,67
Peso do filé	200,98	224,10*	223,62*	193,54
Rendimento de filé	37,57	38,90	35,93	37,54

*Médias diferem do tratamento controle pelo teste de Dunnett ao nível de 5%.



Eli da Silva, I. 2021

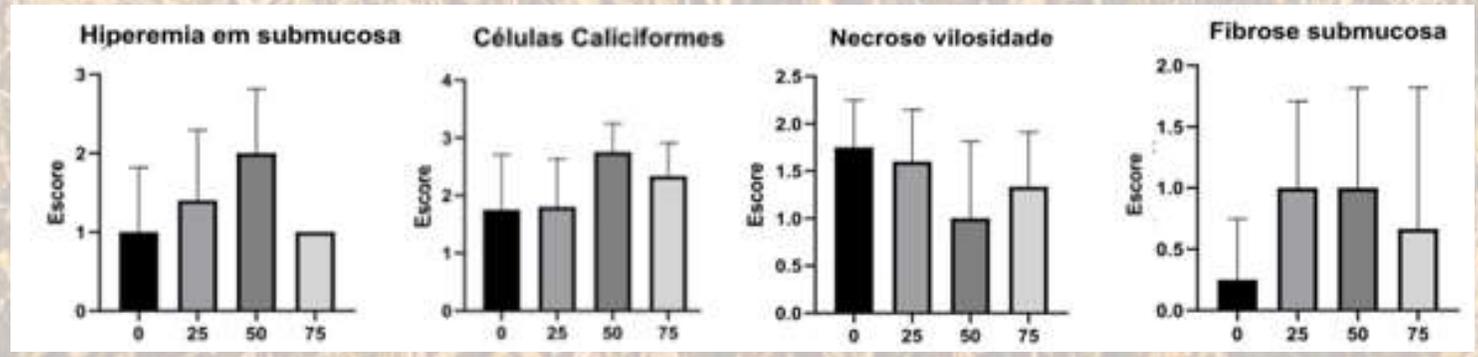
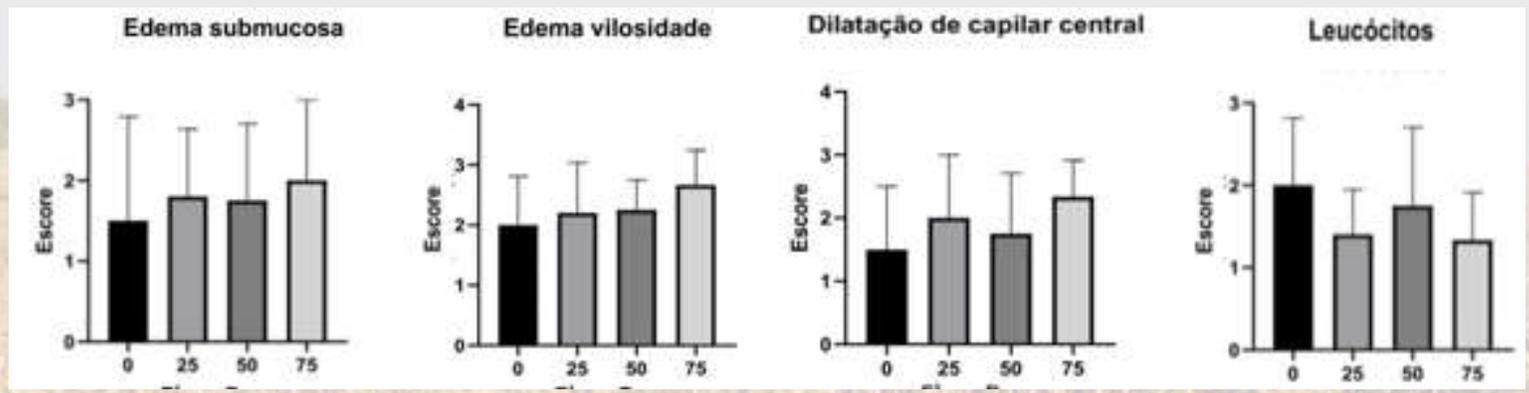


Tabela 6. Médias das variáveis atividade da superóxido dismutase (SOD), Lisozima, Ig total (imunoglobulina) e Atividade hemolítica da via alternativa do complemento (ACH (U/mL)).

Tratamentos	SOD (U/mL)	Lisozima (U/mL)	ACH (U/mL)	Ig total (g/dL)
Controle	5,65	46,43	92,43	3,36
HP-25	6,29	45,63	112,36	3,39
HP-50	6,43	44,45	117,07	2,88
HP-75	5,57	45,61	69,52	2,61
p-valor	0,19	0,46	0,16	0,06
CV %	22,21	7,33	45,34	29,20

Teste F da análise de variância (ANOVA) ao nível de 5%.

Tendências de diminuição de Ig totais

- Evidencia tendência de melhora na imunidade dos peixes



INCLUSION OF A HIGH PROTEIN DISTILLERS DRIED GRAINS PRODUCT IN NILE TILAPIA DIETS.

Table 1:- Proximate chemical analysis of experimental dietary ingredients as fed basis (%).

Ingredient	Moisture	Crude Protein	Ether Extract	Crude Fiber	Ash	NFE*
Fish Meal	6.4	70.0	10.2	1.08	11.4	0.92
Soybean Meal	9.8	44.5	2.4	4.9	6.2	32.2
Yellow Corn	9.3	7.8	2.18	2.3	1.85	76.57
DDGS	9.0	26.5	8.2	10.0	5.1	41.2
HPDDGS	8.9	44.0	6.7	3.2	4.1	33.1

*NFE (nitrogen free extract) = 100 - (moisture + crude protein + ether extract + Crude Fiber + Ash)

Table 2:- Ingredient Composition of the experimental diets used in the feeding trial

Ingredient	Control	Diet DDGS%			Diet HPDDGS%		
		15	30	45	15	30	45
Fish meal	6	6	6	6	6	6	6
Soybean	54	47	39	31	39	24	9
Yellow corn	30	23	17	11	30.15	30.85	31.05
DDGS	-	15	30	45	-	-	-
HPDDGS	-	-	-	-	15	30	45
Fish oil	2	2	2	2	2	2	2
Corn oil	4	3	2	1	3.5	2.5	2
Premix (Vit. & Mins.)	3	3	3	3	3	3	3
Calcium mono phosphate	1	1	1	1	1	1	1
Lycine-HCl	-	-	-	-	.35	.65	.95
Total	100	100	100	100	100	100	100

INCLUSION OF A HIGH PROTEIN DISTILLERS DRIED GRAINS PRODUCT IN NILE TILAPIA DIETS.

Table 4:-Essential amino acid analysis of the experimental diets (g/ 100 g crude protein), used in the feeding trial, and amino acid requirements for Nile tilapia after (Santiago and Lovell, 1988).

Amino acid	Control	Diet DDGS%			Diet HPDDGS%			Requirements
		15	30	45	15	30	45	
Therionine	4.27	4.15	4.20	4.32	4.06	3.93	3.86	3.75
Methionine	2.74	2.72	2.64	2.50	2.78	2.72	2.66	2.68
Isoleucine	3.36	3.11	3.22	3.23	3.37	3.54	3.15	3.11
Leucine	7.37	7.61	8.36	8.22	8.84	9.68	10.32	3.39
Phenylalanine	4.89	4.70	4.91	4.83	5.07	5.30	5.03	3.75
Valine	4.21	4.05	4.29	4.51	4.39	4.45	4.28	2.80
Lysine	5.51	5.18	5.14	4.22	5.34	5.39	5.42	5.12
Histidine	2.64	2.56	2.57	2.59	2.55	2.44	2.27	1.72
Arginine	6.62	6.35	6.11	5.95	5.99	4.91	4.32	4.20

Table 5:-Growth performance of tilapia fish (*Oreochromis niloticus*) fed on experimental diets.

Item	Control	Diet DDGS%			Diet HPDDGS%		
		15	30	45	15	30	45
Initial weight (g/fish)	2.25 ^a	2.24 ^a	2.25 ^a	2.26 ^a	2.24 ^a	2.26 ^a	2.25 ^a
Final weight (g/fish)	16.36 ^c	16.49 ^c	16.33 ^c	12.50 ^d	16.83 ^b	17.17 ^a	16.54 ^c
Weight gain (g/fish)	14.11 ^c	14.25 ^c	14.07 ^c	10.24 ^d	14.58 ^b	14.91 ^a	14.29 ^c
Average daily gain (g/fish/day)	0.168 ^a	0.170 ^a	0.168 ^a	0.122 ^a	0.174 ^a	0.178 ^a	0.170 ^a
Specific growth rate (%/day)	2.36a ^b	2.380 ^{ab}	2.35 ^b	2.04 ^c	2.40 ^{ab}	2.42 ^a	2.37 ^{ab}

Different superscript letters for each row indicate statistically significant difference ($P \leq 0.05$).

INCLUSION OF A HIGH PROTEIN DISTILLERS DRIED GRAINS PRODUCT IN NILE TILAPIA DIETS.

Table 6:- Feed utilization parameters of *Oreochromis niloticus* fish fed the 7 experimental diets.

Item	Control	Diets DDGS%			Diets HPDDGS%		
		15	30	45	15	30	45
Feed conversion ratio (FCR)	1.65 ^b	1.60 ^{bc}	1.63 ^{bc}	1.94 ^a	1.59 ^c	1.58 ^c	1.60 ^{bc}
Protein efficiency ratio (PER)	1.98 ^b	2.02 ^{ab}	2.00 ^b	1.66 ^c	2.06 ^a	2.05 ^a	2.02 ^{ab}
Protein productive value -PPV%	29.05 ^{ab}	29.73 ^{ab}	30.71 ^{ab}	26.43 ^b	34.9 ^a	32.15 ^{ab}	33.48 ^a

Different superscript letters for each row indicate statistically significant difference ($P \leq 0.05$).

DDGs – Sem diferenças F. Soja

- Inclusão até 30%

HPDDG – Mais benefícios

- 30% Inclusão

Table 5:- Growth performance of tilapia fish (*Oreochromis niloticus*) fed on experimental diets.

Item	Control	Diet DDGS%			Diet HPDDGS%		
		15	30	45	15	30	45
Initial weight (g/fish)	2.25 ^a	2.24 ^a	2.25 ^a	2.26 ^a	2.24 ^a	2.26 ^a	2.25 ^a
Final weight (g/fish)	16.36 ^c	16.49 ^c	16.33 ^c	12.50 ^d	16.83 ^b	17.17 ^a	16.54 ^c
Weight gain (g/fish)	14.11 ^c	14.25 ^c	14.07 ^c	10.24 ^d	14.58 ^b	14.91 ^a	14.29 ^c
Average daily gain (g/fish/day)	0.168 ^a	0.170 ^a	0.168 ^a	0.122 ^a	0.174 ^a	0.178 ^a	0.170 ^a
Specific growth rate (%/day)	2.36a ^b	2.380 ^{ab}	2.35 ^b	2.04 ^c	2.40 ^{ab}	2.42 ^a	2.37 ^{ab}

Different superscript letters for each row indicate statistically significant difference ($P \leq 0.05$).

An underwater photograph showing a diver's fin in the foreground, slightly out of focus. The water is clear and blue, with sunlight filtering through from above, creating a shimmering effect. The background is a bright blue sky visible through the water's surface.

“

Considerações finais

Uso do DDGs e HPDDG

Pode substituir componentes vegetais quanto animais na ração;

Palatável;

Presença de Leveduras, seus produtos e compostos bioativos;

Boa concentração de Ácido Linolênico (18:2n-6)

Complemento AA's essenciais (Lys)

Atenção à resíduos de ATB e Micotoxinas

Presença de xantofilas

Atenção à peletização/extrusão

An underwater photograph showing a large, dark-colored fish, possibly a shark, swimming towards the camera. The water is clear and blue, with sunlight filtering through from above, creating a bright, shimmering effect. The fish's body is dark and textured, and its fins are visible. The overall scene is dynamic and captures a moment of marine life.

OBRIGADO !!!

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