Table 2.1: Sorghum area (1000 fed,) and production (1000 M.T) in different states of the Sudan, season 1999/00

State	Area	Production
Northern State	30,000	12,000
Nile	150,000	174,000
Gedarif	3,054,000	193,000
Kassala	313,000	94,000
Red Sea	30,000	4,000
Khartoum	N.A	N.A
Gezira	263,000	234,000
Blue Nile	64,000	33,000
White Nile	730,000	399,000
Sinnar	915,000	33,000
Northern Kordofan	915,000	23,000
Southern Kordofan	640,000	107,000
Western Kordofan	640,000	107,000
Northern Darfur	40,000	4,000
Southern Darfur	700,000	118,000
Western Darfur	225,000	138,000

Source: Agricultural Statistics Department, Ministry of Agriculture and Forestry, July, 2001.

Table (2.2): Sorghum area (1000 fed.) and production (1000 M.T) compared to wheat and millet, season 1992/93-1999/00

Season	Sorghum		Wheat		Millet	
	Area	Production	Area	Production	Area	Production
1992/93	14762	4042	782	453	3710	449
1993/94	11152	2386	851	475	2345	221
1994/95	15303	3648	662	448	7707	973
1995/96	12007	2450	709	527	5758	385
1996/97	15602	4179	784	642	3889	440
1997/98	12645	2922	607	535	6685	943
1998/99	15024	4284	378	284	6577	670
1999/20	10780	2347	244	214	8213	499

Source: Department of Statistics, Ministry of Agriculture and Forestry, 2001.**Table (2.3): Sorghum consumption (1000 M.T) in sorghum producing countries**

Consumption	2000/01	2001/02	2002/03	2003/04	2004/05
Argentina	2500	2300	2250	1900	2200
Australia	1305	1655	1405	1405	1655
Brazil	1000	800	1850	1650	2000
P. R. of China	2561	2700	2825	2950	2800
EU-25	640	679	705	1970	600
Egypt	750	750	750	750	750
Ethiopia	1849	1830	1105	1700	1400
India	7716	8300	7150	7350	6500
Japan	2045	1775	1575	1500	1400
Mexico	11200	10750	9900	9800	10300
Niger	425	675	725	750	645
Nigeria	7700	7750	7800	7950	8000
Sudan	2600	4000	3500	4500	4500
U. R. of Tanzania	335	550	860	580	650
Uganda	360	400	350	375	350
Burkina Faso	1000	1200	1260	1520	1300
Others	4370	4292	4353	4612	4395
Subtotal	48099	50495	48562	51200	49585

United States	6543	6427	4939	5594	6731
World total	54642	56922	53501	56794	56316

Source: Ministry of Council of Ministers.

Table (4.1): Physical analyses of sorghum grains

Cultivar	Hectolitre weight (g)	1000 kernels weight (g)	Impurities (%)	Broken seeds (%)	Shrunken seeds (%)	Foreign seeds (%)
Tetron	760.88	23.17	3.54	0.16	0.16	0.03
Hageen	770.03	23.49	2.64	2.03	0.35	0.69
Feterita-Gedairf	719.99	24.56	2.55	2.22	2.68	0.04

Table (4.2): Decortication and hardness in relation to physical characteristics of sorghum grains

Sorghum cultivar	Kernel hardness* (g)	Kernel size (vision)	Kernel shape	1000 kernels weight (g)	Hectoliter weight (g)
Tetron	12.00^{C}	Large	Spherical	23.17	760.88
Hageen	12.62^{B}	Medium	Spherical	23.49	770.03
Feterita Gedairf	17.38^{A}	Large	Flat	24.56	719.99

* Grams of matter removed per 100 grams of whole grain.

Means with different letters with a column are significantly different from each other (P≤0.05).

Table (4.3): Proximate composition of sorghum grains [(100% Ex. R.) (D.B)]

Cultivar	Moisture	Protein	Ash	Fat	Fibre	CHO
Tetron	6.52	14.50	1.38	4.12	2.83	73.48
Hageen	6.23	11.37	1.45	4.03	2.99	76.92
Feterita-Gedarif	8.02	17.15	1.70	3.98	2.83	69.15

Table (4.4): Effect of different decortication methods on the chemical composition of Tetron grains*

Decortication methods**	Moisture	Protein	Ash	Fat	Fibre	CHO
Not decorticated	6.52^{A}	14.17^{A}	1.38^{A}	4.12^{A}	2.83^{A}	73.81^{C}
Dec. 1	6.33^{B}	12.54^{B}	1.11^{B}	2.75^{B}	2.00^{B}	77.27^{B}
Dec. 2	5.38^{D}	11.27^{C}	0.89^{C}	2.40^{C}	1.85^{C}	80.06^{A}
Dec. 3	5.90^{C}	12.75^{B}	1.15^{B}	2.75^{B}	1.80^{C}	77.44^{B}

* Mean values having different superscript letters in columns differ significantly at ($P \leq 0.05$).

** Decortication methods:-

Not decorticated = Control
Dec. 1 = Traditional
Dec. 2 = Familiar

Dec. 3 = Advanced**Table (4.5): Effect of different decortication methods on the chemical composition of Hageen grains***

Decortication methods**	Moisture	Protein	Ash	Fat	Fibre	CHO
Not decorticated	6.23^{A}	11.37^{A}	1.45^{A}	4.03^{A}	2.99^{A}	76.92^{C}
Dec. 1	6.22^{AB}	10.20^{B}	1.22^{B}	3.12^{B}	2.00^{C}	79.24^{B}
Dec. 2	6.17^{B}	8.96^{C}	0.82^{D}	2.00^{D}	2.20^{B}	82.05^{A}
Dec. 3	5.90^{C}	9.19^{C}	1.01^{C}	2.73^{C}	1.80^{D}	81.17^{A}

* Mean values having different superscript letters in columns differ significantly at ($P \leq 0.05$).

** Decortication methods:-

Not decorticated = Control
Dec. 1 = Traditional
Dec. 2 = Familiar

Dec. 3 = Advanced

Table (4.6): Effect of different decortication methods on the chemical composition of Feterita-Gedarif grains*

Decortication methods**	Moisture	Protein	Ash	Fat	Fibre	CHO
Not decorticated	8.02^{A}	17.15^{A}	1.70^{A}	3.98^{A}	2.83^{A}	70.15^{D}
Dec. 1	7.63^{B}	14.54^{B}	1.26^{B}	3.36^{B}	2.25^{C}	73.21^{C}
Dec. 2	5.53^{C}	13.35^{C}	1.04^{C}	2.62^{D}	2.30^{B}	77.46^{A}
Dec. 3	5.55^{C}	14.58^{B}	1.31^{B}	2.98^{C}	2.00^{D}	75.58^{B}

* Mean values having different superscript letters in columns differ significantly at ($P \leq 0.05$).

** Decortication methods:-

Not decorticated = Control
Dec. 1 = Traditional
Dec. 2 = Familiar

Dec. 3 = Advanced **Table (4.7):Losses in chemical composition of sorghum grains as affected by different decortication methods (%)**

Decortication method	Tetron					Hageen					Feterita-Gedarif				
	Moisture	Protein	Ash	Fat	Fibre	Moisture	Protein	Ash	Fat	Fibre	Moisture	Protein	Ash	Fat	Fibre
Dec. 1	2.91	13.52	19.57	37.25	29.33	0.16	10.29	15.86	22.58	33.11	4.86	15.22	25.88	15.58	20.49
Dec. 2	17.48	22.28	35.51	41.75	34.63	0.96	21.20	43.45	50.37	26.42	6.11	22.16	38.82	34.17	18.73
Dec. 3	9.51	12.07	16.67	33.25	36.40	5.30	10.88	30.34	32.26	39.80	5.86	14.99	22.94	25.13	29.33

Table (4.8): Minerals content (mg/100 g) of whole sorghum grains (D.B)

Sorghum cultivars	Minerals									
	K	Na	Mg	P	Ca	Mn	Al	Fe	Cu	Zn
Tetron	480.80	5.53	159.54	245.65	38.72	1.98	1.47	6.08	1.89	4.09
Hageen	365.16	4.76	160.41	224.98	48.18	1.69	1.09	3.22	0.47	3.16
Feterita-Gedarif	428.71	11.02	186.17	288.93	37.14	1.09	1.37	4.71	0.49	3.92

Table :(4.9) Effect of different decortication methods on minerals content (mg/100 g) of Tetron grains*

Decortication method**	Minerals									
	K	Na	Mg	P	Ca	Mn	Al	Fe	Cu	Zn
Not decorticated	480.80^{A}	5.53^{A}	159.54^{A}	245.65^{A}	38.72^{A}	1.98^{A}	1.47^{A}	6.08^{A}	1.89^{A}	4.09^{A}
Dec. 1	289.72^{B}	2.89^{B}	153.27^{B}	184.40^{B}	24.03^{B}	1.21^{B}	1.08^{B}	3.36^{B}	0.51^{B}	3.35^{B}
Dec. 2	285.34^{b}	2.61^{B}	142.98^{B}	177.82^{C}	23.99^{B}	0.95^{C}	1.06^{B}	2.86^{C}	0.62^{B}	2.77^{C}
Dec. 3	290.53^{b}	2.15^{C}	147.10^{B}	183.0	24.07^{B}	1.04^{C}	0.87^{C}	2.89^{C}	0.46^{B}	2.69^{C}

				7^{B}						

* Mean values having different superscript letters in columns differ significantly at (P≤0.05).

** Decortication methods:-

Not decorticated = Control

Dec. 1 = Traditional

Dec. 2 = Familiar

Dec. 3 = Advanced

Table (4.10): Effect of different decortication methods on minerals content (mg/100 g) of Hageen grains*

Decortication method**	K	Na	Mg	P	Ca	Mn	Al	Fe	Cu	Zn
Not decorticated	365.16 A	4.76 A	160.41 A	224.98 A	48.18^{A}	1.69^{A}	1.09^{A}	3.22^{A}	0.47^{A}	3.16^{A}
Dec. 1	350.55 B	2.88 B	125.42 B	175.07 C	20.47^{B}	1.49^{A}	0.58^{B}	2.81^{B}	0.27^{B}	1.91^{B}
Dec. 2	282.45 D	1.92 C	82.91^{D}	182.72 B	08.34^{D}	0.89^{C}	0.30^{C}	2.27^{C}	0.22^{B}	0.85^{C}
Dec. 3	341.05 C	2.34 C	115.22 C	160.97 D	14.66^{C}	1.27^{B}	0.73^{B}	2.80^{B}	0.25^{B}	2.03^{B}

* Mean values having different superscript letters in columns differ significantly at (P≤0.05).
** Decortication methods:-
Not decorticated = Control

Dec. 1 = Traditional
Dec. 2 = Familiar

Dec. 3 = Advance**Table (4.11) Effect of different decortication methods on minerals content (mg/100 g) of Feterita-Gedarif grains***

Decortication method**	Minerals									
	K	Na	Mg	P	Ca	Mn	Al	Fe	Cu	Zn
Not decorticated	428.70^{A}	11.02^{A}	186.17^{A}	288.93^{A}	37.14^{A}	1.09^{A}	1.37^{A}	4.71^{A}	0.49^{A}	3.92^{A}
Dec. 1	308.91^{C}	2.12^{C}	92.04^{C}	194.75^{B}	6.21^{C}	0.99^{A}	1.33^{A}	2.28^{C}	0.47^{A}	1.28^{B}
Dec. 2	276.36^{D}	4.01^{B}	129.16^{B}	179.97^{D}	18.83^{B}	1.01^{A}	0.60^{B}	3.42^{B}	0.44^{A}	3.32^{A}
Dec. 3	352.83^{B}	2.56^{C}	125.42^{B}	185.60^{C}	19.34^{B}	1.06^{A}	0.66^{B}	3.29^{B}	0.47^{A}	3.36^{A}

* Mean values having different superscript letters in columns differ significantly at (P≤0.05).

** Decortication methods:-
Not decorticated = Control
Dec. 1 = Traditional
Dec. 2 = Familiar

Dec. 3 = Advanced**Table (4.12): Losses in minerals content of sorghum grains as affected by different decortication methods (%)**

Minerals	Tetron			Hageen			Feterita-Gedarif		
	Dec. 1	Dec. 2	Dec. 3	Dec. 1	Dec. 2	Dec. 3	Dec. 1	Dec. 2	Dec. 3
K	39.74	40.65	39.57	27.94	35.54	41.02	4.00	22.65	6.60
Na	47.74	52.80	61.12	80.76	63.61	76.77	39.50	59.66	50.84
Mg	3.93	10.38	7.80	50.56	30.62	32.62	21.81	48.31	28.17
P	24.93	27.61	25.48	22.18	18.78	28.45	32.60	37.71	35.76
Ca	37.94	38.04	37.84	83.28	49.30	47.93	57.51	82.69	69.57
Mn	38.89	52.02	47.47	9.17	7.34	2.75	11.83	47.34	24.85
Al	26.53	27.89	40.82	2.92	56.20	51.82	46.79	72.48	33.03
Fe	44.74	52.96	52.47	51.59	27.39	30.15	12.73	29.50	13.04
Cu	73.02	67.20	75.66	4.08	10.20	4.08	42.55	53.19	46.81
Zn	18.09	32.27	24.23	67.35	15.31	14.28	39.56	73.10	35.76

Table (4.13): Tannin and phytic acid contents of sorghum whole grains (D.B.)

Cultivar	Tannin (%)	Phytic acid (%)
Tetron	0.39	673.97
Hageen	0.37	221.75
Feterita-Gedarif	0.36	466.05

Table (4.14): Effect of different decortication methods on tannin content (%) of whole sorghum grains*

Decortications method**	Cultivars		
	Tetron	Hageen	Feterita-Gedarif
Not decorticated	0.39^{A}	0.37^{A}	0.36^{AB}
Dec. 1	0.35^{AB}	0.36^{AB}	0.31^{BC}
Dec. 2	0.33^{ABC}	0.36^{AB}	0.28^{C}
Dec. 3	0.35^{AB}	0.37^{A}	0.29^{C}

* Mean values having different superscript letters in rows (decortication methods) and columns (cultivars) differ significantly at ($P \leq 0.05$).

** Decortication methods:-

Not decorticated = Control

Dec. 1 = Traditional
Dec. 2 = Familiar
Dec. 3 = Advanced

Table (4.15): Losses in tannin content of sorghum grains as affected by different decortication methods (%)

Decortication method	Cultivars		
	Tetron	Hageen	Feterita-Gedarif
Dec. 1	10.26	2.70	13.89
Dec. 2	15.38	2.70	22.22
Dec. 3	10.26	0.00	19.44

** Decortication methods:-

Dec. 1 = Traditional
Dec. 2 = Familiar

Dec. 3 = Advanced **Table (4.16): Effect of different decortication methods on phytic acid content (mg P/100 g) of sorghum grains***

Decortication method**	Cultivars		
	Tetron	Hageen	Feterita-Gedarif
Not decorticated	673.97^{A}	221.75^{BC}	466.06^{AB}
Dec. 1	263.61^{BC}	69.26^{C}	286.08^{BC}
Dec. 2	466.98^{AB}	168.44^{C}	192.59^{BC}
Dec. 3	276.17^{BC}	138.10^{C}	178.83^{C}

* Mean values having different superscript letters in rows (decortication methods) and columns (cultivars) differ significantly at ($P \leq 0.05$).

** Decortication methods:-

Not decorticated = Control

Dec. 1 = Traditional
Dec. 2 = Familiar
Dec. 3 = Advanced

Table (4.17) : Losses in phytic acid content of sorghum grains as affected by different decortication methods (%)

Decortication method	Cultivars		
	Tetron	Hageen	Feterita-Gedarif
Dec. 1	60.89	68.77	38.62
Dec. 2	30.77	24.04	58.68
Dec. 3	59.02	37.73	61.63

** Decortication methods:-

Not decorticated = Control
Dec. 1 = Traditional
Dec. 2 = Familiar

Dec. 3 = Advanced

Table (4.18): Organoleptic evaluation of aceda product from Tetron grains (whole meal and flours from different decortication methods)

Dec. method	Sum of Ranks*				
	Appearance	Odour	Taste	Texture	Overall preference
Not decorticated	53[c]	43[b]	45[b]	50[b]	47[b]
Dec. 1	35[b]	32[b]	32[b]	29[a]	32[b]
Dec. 2	17[a]	30[b]	27[a]	31[b]	24[a]
Dec. 3	40[b]	47[b]	54[c]	35[b]	51[c]

* Sum of ranks values having different superscript letters in columns differ significantly at (P≤0.05).

** Decortication methods:-

Not decorticated	= Control
Dec. 1	= Traditional
Dec. 2	= Familiar
Dec. 3	= Advanced

Table (4.19): Organoleptic evaluation of aceda product from Hageen grains (whole meal and flours from different decortication methods)

Dec. method	Sum of Ranks*				
	Appearance	Odour	Taste	Texture	Overall preference
Not decorticated	56[c]	46[b]	52[c]	43[b]	53[c]
Dec. 1	51[c]	47[b]	48[b]	51[c]	50[b]
Dec. 2	19[a]	35[b]	31[b]	28[a]	26[a]
Dec. 3	32[b]	34[b]	32[b]	34[b]	32[b]

* Sum of ranks values having different superscript letters in columns differ significantly at (P≤0.05).

** Decortication methods:-

Not decorticated	= Control
Dec. 1	= Traditional
Dec. 2	= Familiar
Dec. 3	= Advanced

Table (4.20): Organoleptic evaluation of aceda product from Feterita - Gedarif grains (whole meal and flours from different decortication methods)

Dec. method	Sum of Ranks*				
	Appearance	Odour	Taste	Texture	Overall preference
Not decorticated	57[c]	48[b]	39[b]	42[b]	48[b]
Dec. 1	38[b]	41[b]	44[b]	32[b]	36[b]
Dec. 2	16[a]	32[b]	32[b]	32[b]	22[a]
Dec. 3	44[b]	42[b]	44[b]	54[c]	49[b]

* Sum of ranks values having different superscript letters in columns differ significantly at (P≤0.05).

** Decortication methods:-

Not decorticated	= Control
Dec. 1	= Traditional
Dec. 2	= Familiar
Dec. 3	= Advanced