

## LIST OF TABLES

<u>Table Number</u>	<u>Title</u>	<u>Page</u>
1.	Distribution of water used by sector in Egypt.....	4
2.	Water consumption rates for industries in Egypt.....	5
3.	Rice size classification.....	13
4.	Rice shape classification.....	14
5.	Rice nutrition facts (per 100 g of raw rice).....	15
6.	Protein contents of rice flour.....	17
7.	Amino acid composition of rice protein and their fractions.....	17
8.	Composition of lipids in rice and its fractions.....	18
9.	Content of elements in rice milling and polishing.....	19
10.	Vitamin content ( $\mu\text{g/g}$ dry matter) in milled and polishing rice.....	20
11.	Egyptian standard specifications for broken rice.....	21
12.	Chemical composition of broken rice (grades zero, 1 and grade 2).....	22
13.	Water consumption in the starch processing industry.....	22
14.	Chemical composition of rice starch wastewater.....	25
15.	Most common concentrate and roughage feeds used by commercial..... feedlots.....	31
16.	Livestock num .and kinds at governorates year 2010.....	34
17.	Factories animal foddering in Egypt governorates and its production capacity at year 2010.....	35
18.	Starch production situation in E.S.Y.D.....	36
19.	Composition of basic experimental diet.....	48
20.	Water consumption per day in starch manufacturing process.....	56
21.	Wastewater generation from starch manufacture process.....	57
22.	Chemical composition of broken rice flour (grade zero & grade one).....	58
23.	pH of wastewater in the different sampling sites.....	59
24.	Temperature of wastewater in the different sampling sites ( $^{\circ}\text{C}$ ).....	59
25.	Total solids (mg/l) in wastewater in the different sampling sites.....	60
26.	Total suspended solids (mg/l) in wastewater in the different sampling sites.	61
27.	Total dissolved solids (mg/l) in wastewater in the different sampling sites...	61

28. COD (mg/l) in wastewater in the different sampling sites.....	62
29. BOD (mg/l) in wastewater in the different sampling sites.....	63
30. Crude protein content (gm/100ml) in wastewater in the different sampling sites.....	64
31. Crude fat content (gm/100ml) in wastewater in the different sampling sites	64
32. Crude fiber content (gm/100ml) in wastewater in the different sampling sites.....	65
33. Ash content (gm/100ml) in wastewater in the different sampling sites.....	66
34. Total carbohydrates content (gm/100ml) in wastewater in the different sampling sites.....	66
35. Sodium chloride content (gm/100ml) in wastewater in the different sampling sites.....	67
36. Effect of pH on proteins (solubility – precipitated).....	68
37. Variation of wastewater characteristics at different time.....	69
38. Comparison between the characteristics of wastewater before and after treatment.....	70
39. Chemical composition of drying separated material of wastewater from settling tank.....	71
40. Amounts of wastewater discharged at current and maximum capacity operating rate.....	72
41. Expected production quantities of new by-product.....	72
42. Composition and chemical analysis of experimental diets.....	73
43. Effect of treatment on digestion parameters.....	74
44. Effect of treatment on blood hemoglobin (Hb).....	78
45. Effect of treatment on white blood cells (WBCs).....	79
46. Effect of treatment on red blood cells (RBCs).....	80
47. Effect of treatment on blood HCT.....	81
48. Effect of on blood MCV.....	82
49. Effect of treatment on blood MCH.....	83
50. Effect of treatment on blood MCHC.....	84
51. Effect of treatment on serum urea.....	85
52. Effect of treatment on serum creatinine.....	87
53. Effect of treatment on serum uric acid.....	88

54. Effect of treatment on serum alanine aminotransferase (ALT).....	90
55. Effect of treatment on serum aspartate aminotransferase (AST).....	91
56. Effect of treatment on serum alkaline phosphatase (ALP).....	92
57. Effect of treatment on serum acid phosphatase (ACP).....	93
58. Effect of treatment on serum bilirubin.....	94
59. Effect of treatment on serum total protein (TP).....	95
60. Effect of treatment on serum albumin.....	97
61. Effect of treatment on serum globulin.....	98
62. Effect of treatment on serum total lipids (TL).....	99
63. Effect of treatment on serum triglycerides (TG).....	100
64. Effect of treatment on serum cholesterol.....	102
65. Effect of treatment on serum low –density lipoproteins-cholesterol (LDL).	103
66. Effect of treatment on serum high –density lipoproteins (HDL).....	105
67. Effect of treatment on serum very low-density lipoprotein (VLDL).....	106
68. Effect of treatment on serum thiobarbituric acid (TBARS).....	107
69. Effect of treatment on serum amylase.....	108
70. Effect of treatment on serum glucose.....	109
71. Effect of treatment on internal organs weight ratio.....	111

## **LIST OF FIGURES**

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
1.	Section of the amylose molecule.....	8
2.	Section of the amylopectin molecule.....	9
3.	Structure of starch from atomic to granular level starting from amylose and amylopectin to complete granules.....	9
4.	Classification of starch and starch derivatives.....	10
5.	Development of world output of all types of starch products.....	11
6.	World market for starch by raw materials.....	11
7.	Global rice paddy production and area.....	12
8.	Structure of rice grain.....	13
9.	Condensation of two amino acids resulting in a dipeptide.....	16
10.	Alkali steep method for rice starch production.....	24
11.	Sedimentation tank.....	27
12.	Centre sieve.....	28
13.	Decanting centrifuge.....	28
14.	Hydro cyclone.....	29
15.	Rice starch production process at ESYD.....	38
16.	pH meter .....	39
17.	Effect of pH on protein solubility in wastewater.....	68
18.	Changing of wastewater characterization with changing time.....	69
19.	Centrifuge machine (Model Universal 32 R).....	70
20.	Effect of treatment on body weight gain.....	75
21.	Effect of treatment on body weight gain ratio.....	75
22.	Effect of treatment on feed intake.....	76
23.	Effect of treatment on feed efficiency ratio.....	76
24.	Effect of treatment on water intake.....	77
25.	Effect of treatment on blood hemoglobin.....	78
26.	Effect of treatment on white blood cells (WBCs).....	79
27.	Effect of treatment on red blood cells.....	80

28. Effect of treatment on blood HCT.....	81
29. Effect of treatment on blood MCV.....	82
30. Effect of treatment on MCH.....	83
31. Effect of treatment on blood MCHC.....	84
32. Effect of treatment on serum urea.....	86
33. Effect of treatment on serum creatinine.....	87
34. Effect of treatment on serum uric acid.....	88
35. Effect of treatment on serum alanine aminotransferase (ALT).....	90
36. Effect of treatment on serum aspartate aminotransferase (AST).....	91
37. Effect of treatment on serum alkaline phosphatase (ALP).....	92
38. Effect of treatment on serum acid phosphatase (ACP).....	93
39. Effect of treatment on serum bilirubin.....	94
40. Effect of treatment on serum total protein (TP).....	96
41. Effect of treatment on serum albumin.....	97
42. Effect of treatment on serum globulin.....	98
43. Effect of treatment on serum total lipids (TL).....	99
44. Effect of treatment on serum triglycerides (TG).....	101
45. Effect of treatment on serum cholesterol.....	102
46. Effect of treatment on serum low –density lipoproteins (LDL).....	104
47. Effect of treatment on serum high –density lipoproteins (HDL).....	105
48. Effect of treatment on serum very low-density lipoprotein (VLDL).....	106
49. Effect of treatment on serum thiobarbituric acid (TBARS).....	107
50. Effect of treatment on serum amylase.....	108
51. Effect of treatment on serum glucose.....	110
52. Effect of treatments on heart ratio.....	111
53. Effect of treatments on kidney ratio.....	111
54. Effect of treatments on liver ratio.....	112
55. Photomicrograph of liver from rats after 8 weeks of treatments.....	114
56. Photomicrograph of kidneys from rat after 8 weeks of treatments...	115

## **List of abbreviations**

ACP	Acid phosphatase
ADP	Adenosine di phosphate
ALP	Alkaline phosphatase
ALT	Alanine amino transaminase
AO	American optics
AST	Aspartate amino transaminase
ATP	Adenosine tri phosphate
BOD	Biological oxygen demand
BPF	by-product feedstuffs
BWGR	Body weight gain ratio
CBR L	Cooked brown rice low amylose
CBRH	Cooked brown rice high amylose
CF	Crude fiber
COD	Chemical oxygen demand
CP	Crude protein
CPGBRL	Cooked pre-germinated brown rice low amylose
CWRH	Cooked white rice high amylose
CWRL	Cooked white rice low amylose
DE	Digestible energy
DFRB	Defatted rice bran
DM	Dry matter
DO	Dissolved oxygen
E	Eosinophilic material
E.S.Y.D	Egyptian starch, yeast and detergent company
EE	Ether extract
FAO	Food and Agriculture Organization
FAT	Fatty acid transporter
FER	Feed efficiency ratio
FI	Feed intake

GDP	Gross domestic product
GE	Gross energy
GFR	Glomerular filtration rate
GK	Glycerol kinase
GPO	Glycerol phosphate oxidase
H	Hepatic architecture
Hb	Hemoglobin
HDL	High density lipoprotein-cholesterol
IEP	Isoelectric point
LDL	Low density lipoprotein-cholesterol
LPL	lipoprotein lipase
MCH	Mean corpuscular hemoglobin
MCHC	Mean corpuscular hemoglobin concentration
MCV	Mean corpuscular volume
NDF	Neutral detergent fiber
NFE	Nitrogen free extract
NS	No significant
OM	Organic matter
PCV	Packed cell volume
PI	Portal inflammation
R B	Rice bread
RBC	Red blood cell
RBO	Rice bran oil
RP-A	Rice protein precipitation with acidic solution
RP-E	Rice protein precipitation with enzymes
RSMBP	Rice starch manufacture by-product
SGOT	Serum glutamic oxaloacetic transaminase
SS	Suspended solid
TBARS	Thiobarbituric acid–reactive substances
TDS	Total dissolved solids
TG	Triglycerides

TL	Total lipids
TP	Total protein
TS	Total solids
VLDL	Very-low-density lipoprotein
WBC	White blood cell
WG	Weight gain
WI	Water intake